Services to Develop Procedures and Tools to Delineate Areas Designated or Used for Class II Well Wastewater Injectate









**TWDB Contract # 2000012453** 

1<sup>st</sup> Workgroup Meeting: December 02, 2020



vsp

# **Technical Approach**

- Project objective
  - buffer zone
- Technical approach
- Identification of Models
  - literature and information review
  - preliminary modeling
  - aquifer assessment: parameters
  - UIC data analysis: RRC
- Model development
  - input dataset
  - deliverables requirement

## **Project Schedule – WSP**

DD: Data deliverables; RD: Report deliverables; TT: Technology transfer PM: Project management; TM: Technical communication with TWDB staff SM: Stakeholder meetings as organized by the TWDB staff

Tasks	2020			2021							
	0	N	D	J	F	Μ	A	М	J	J	А
Task 1: Literature Review											
Task 2: Aquifer Assessment											
Task 3: Aquifer Assessment Presentation						)					
Task 4: Class II Well Data Procedures & Tools											
Task 5: Mapping Techniques Description											
Task 6: Techniques Presentation											
Task 7: Injectate Mapping Procedures & Tools											
Task 8: Case Study											
Task 9: Procedures & Tool Testing											
Task 10: Final workgroup presentation											
Task 11: Draft and Final Reports											
Task 12: Project Management											

## **Project Progress**

- Literature Review
  - Dr. Sharp leading the team
  - Specific issues
- Aquifer Assessment
  - TWDB data
  - RRC data
  - Other data
- RRC UIC dataset
  - Data processing
- Modeling Techniques & Tools

## **Literature Review**

- Few studies addressing specific question
  - General background
  - Further suggestions from TWDB/Workgroup
- Reviewed 60+ articles
- Review to continue for the month
- Key issues
  - protection of aquifers
  - seismic activity impacts
  - Injectate clogging formation
- Wide variety of strata suitable for waste water injection.
- Regulatory issues
  - Concentrate disposal permits
  - reliability over the life of the desalination system

## **Aquifer Assessment**

- Project Area
  - Identification of 18 aquifers
- Available data
  - GAM
  - BRACS
  - SDR
  - RRC
- Analysis process

## **Aquifer Assessment**



wsp



![](_page_9_Figure_1.jpeg)

![](_page_10_Figure_1.jpeg)

![](_page_11_Figure_1.jpeg)

![](_page_12_Figure_1.jpeg)

![](_page_13_Figure_1.jpeg)

#### Aquifer Assessment Capitan Reef Complex GAM

![](_page_14_Figure_1.jpeg)

- Total Class II Injection Wells = 3,431
  - 3,016 wells in active dataset (415 missing land surface elevation)
- Wells with Injection Interval Within GAM = 2,845
- Wells with Injection Interval below GAM = 171

# wsp

![](_page_15_Figure_0.jpeg)

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Number of Wells

#### Aquifer Assessment Capitan Reef Complex GAM

![](_page_16_Figure_1.jpeg)

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• BROWN LM.  BERNETT  • RUSTLER.  TAUSTLER.  • YATES / QUEEN    • BRUSHY CANYON  • LOWER PENN.  RUSTLER.  • TAUSTLER.  • YATES / QUEEN    • CAPITAN  • LOWER PENN.  • RUSTLER.  • TAUSTLER.  • YATES / QUEEN    • CAPITAN  • LOWER YATES  • POSSIBLE FLOW:  • TANISLL  • YATES A SAND    • CHERRY CANYON  • LWR 7 RIVERS  • RUSTLER.  • TANISLL  • YATES A SAND    • CLEARFORK  • MICKEE SAND  • RUSTLER.  • TANISLL  • YATES D    • CLEARFORK  • MISSISIPPAN  • RUSTLER.  • TANISLL  • YATES F    • COLBY  • MISSISIPPAN  • SALADO  • TANSILL  • YATES ADD    • COLBY SAND  • OBRIEN  • SALADO SALT  • TOP OF QUEEN  • YATES ADD    • DELAWARE  • PENN  • SAN ANDRES  • TOP OF GUEEN  • YATES (QUEEN    • DELAWARE  • PENN-  • SAN ANDRES.  • TOP OF SEVEN  • YATES (QUEEN    • DELAWARE  • PENN-  • SAN ANDRES.  • TOP OF SEVEN  • YATES (QUEEN    • DELAWARE  • PENN-  • SAN ANGELO  • TOP OF YATES  • YATES (QUEEN    • DELAWARE  • PENN-  • SAN ANGELO  • TOP OF YATES  • YATES (QUEEN    • DELOWIAN  • PENNSUYANIA  <		D BF	ROWN LIME	0	LOWER PENN	٥	RUSTER	0	T/QUEEN	0	YATES (B-C)	×
• BRUSHY CANYON  LOWER PENN. BEINNETT  • PORSOSTY  • YATES 2616    • CAPITAN  • LOWER PENN. BEINNETT  • POSSIBLE FLOW: POSSIBL  • TYATES  • YATES ASAND    • CAPITAN REEF  • LOWER YATES  • UST ER  • TYATES  • YATES ASAND    • CHERRY CANYON  • LWR 7 RIVERS  • RUSTLER. • CHERRY CANYON  • LWR 7 RIVERS  • TANISLL  • YATES ASAND    • CLEARFORK  • MCKEE SAND  • RUSTLER. • ANHYDRITE  • TANISLL  • YATES F    • COLBY  • MISSISIPIPIAN  • RUSTLER.SALADO  • TANSIL  • YATES F    • COLBY OUEEN  • OBRIEN  • SALADO SALT  • TOPOR SEVEN  • YATES SAND    • DELAWARE  • PENN BENNETT  • SAN ANDRES. • HIGH FLOWS, GROUP  • PENN BENNETT  • TOPOR SEVEN  • YATES OUEEN    • DELAWARE  • PENN BENNETT  • SAN ANDRES. • HIGH FLOWS, GROUP  • TOPOR SEVEN  • YATES OUEEN    • DELAWARE  • PENN SAN ANDRES. • DOPOR SEVEN  • TANESL  • YATES OUEEN    • DELAWARE  • PENN SAN ANDRES. • HIGH FLOWS, GROUP  • PENNENNETT  • TAN SILL  • YATES OUEEN    • DELAWARE  • PENN SAN ANDRES. • OF OF FATES  • YATES OUEEN  • YATES OUEEN    • DELAWARE  • PENN SAN ANDRES. • TOPOR SEVEN  • YATES OUEEN    • DEVONIAN  • PENNENT  • SAN ANDRES.		D BF	ROWN LM.		BENNET	٥	RUSTLER		T/RUSTLER	0	YATES / QUEEN	
• CAPITAN  • DOUBLETAN  • POSSIBLE FLOW:  • TATES  • VATES A SAND    • CAPITAN REEF  • DOUBLE FLOW:  • TANILL  • VATES A SAND    • CHERRY CANYON  • LWR 7 RIVERS  • RUSTLER  • TANILL  • VATES C    • CLEARFORK  • MKEE SAND  • ANIVPORTIE  • TANISLL  • VATES D    • CLEARFORK  • MKSEI SSIPPIAN  • RUSTLER/SALADO  • TANISLL  • VATES G    • COLBY  • OBRIEN  • SALADO SALT  • TOBORG  • VATES SAND    • COLBY-QUEEN  • OBRIEN  • SALADO SALT  • TOPO FO GUEN  • VATES SAND    • DELAWARE  • PENN BENNETT  • SAN ANDRES  • TOP OF SEVEN  • VATES C    • DELAWARE  • PENNBENNETT  + HCH FLOWS, GROUP  • TOP OF SEVEN  • VATES C    • DEVONIAN  • PENNENNET  + HCH FLOWS, GROUP  • TOP OF GYATES  • VATES    • DEVONIAN  • SAN ANDRES  • TOP OF GYATES  • VATES/LUEN    • DEVONIAN  • PENNSULVANIAN  • SANADDCLO  • TOP OF GYATES  • VATES    • DEVONIAN  • PENNSULVANIAN  • SANADDOLO  • TOP SEVEN  • VATES    • GLICHETA  • PENNSULVANIAN  • SANDON LIME  • TOP SEVEN  • VATES		D BF	RUSHY CANYON	۰	LOWER PENN. BENNETT		RUSTLER -	0	POROSITY	0	YATES 2616	l l l l l l l l l l l l l l l l l l l
• CAPITAN REEP    • LURR 7 RIVERS    • RUSTLER    • TANILL    • YATES C      • CHERRY CANYON    • MCKEE SAND    • MCKEE SAND    • TANSIL    • YATES D      • CLEARFORK    • MISSISSIPPIAN    • RUSTLER/SALADO    • TANSIL    • YATES F      • COLBY    • OBRIEN    • SALADO    • TANSIL    • YATES G      • COLBY SAND    • OBRIEN    • SALADO    • TANSIL    • YATES G      • COLBY SAND    • OBRIEN    • SALADO SALT    • TOBORG    • YATES SAND      • DELAWARE    • PENN    • SAN ANDRES -    • TOP OF QUEEN    • YATES SAND      • DELAWARE    • PENN-BENNETT    HCH FLOWS, GROUP    • PENN-BENNETT    • TOP OF YATES    • YATES L      • DEVONIAN    • PENN.    • SANA NOELO    • TOP OF YATES    • YATES L      • DEVONIAN    • PENNSLYVANIA    • SANA NOELO    • TOP OF YATES    • YATES L      • EMPEROR, DEEP    • PENNSLYVANIA    • SAND/DOLO    • TOP OF SEVEN    • YATES      • GLORIETA    • PENNSLYVANIA    • SAND/DOLO    • TOP SEVEN    • YATES		D CA	APITAN	•	LOWER VATES	0	POSSIBLE FLOW; POSSIBI	0	T/YATES	0	YATES A SAND	, i i i i i i i i i i i i i i i i i i i
o  CHERRY CANYON  O  CHARRY CANYON  O  CANHYDRITE  o  TANISLL  O  YATES D    o  CLEARFORK  MCKEE SAND  RUSTLERSALADO  O  TANISLL  O  YATES F    o  COLBY  MISSISSIPIAN  SALADO  TANSIL  O  YATES F    o  COLBY SAND  O OBRIEN  SALADO SALADO  TOPORDER  YATES FAX    o  COLBY OUERN  O  GRIEN  SALADO SALT  TOPORDER  YATES SAND    D  DELAWARE  PENN BENNETT  SAN ANDRES  TOP OF FUENS  YATES OUERN    D  DELAWARE  PENNENNETT  HIGH FLOWS, HIGH FLOWS, GROUP  TOP OF SALEN  YATES OUERN    O  DEVONIAN  PENNL  SAN ANDRES, SAN ANDRES  TOP OF FATES  YATES AND    O  DELWARE  PENNENNETT  H2S, CO  TOP OF FATES  YATESL    O  DEVONIAN  PENNL  SAN ANDRESL  TOP OF FATES  YATESL    O  DEVONIAN  PENNL  SAN ANDRESL  TOP OF FATES  YATESL    O  DEVONIAN  PENNL  SAN ANDRESL  TOP OF SEVEN  YATESL    O  DEVONIAN  PENNL  SAN ANDRESL  TOP OF SEVEN  YATESL		D CA	APITAN REEF		IWP 7 RIVERS		RUSTLER	۰	TANILL	0	YATES C	
• CLEARFORK  • MISSISSIPPAN  • RUSTLER/SALADO  • TANSIL  • YATES F    • COLEY  • MISSISSIPPAN  • SALADO  • TANSIL  • YATES G    • COLEY SAND  • OBRIEN  • SALADO SALT  • TOBORG  • YATES G    • COLEY-QUEEN  • OBRIEN  • SALADO SALT  • TOBORG  • YATES GAND    • COLEY-QUEEN  • OBRIEN  • SALADO SALT  • TOBORG  • YATES SAND    • DELAWARE  • PENN BENNETT  • SAN ANDRES  • TOP OF SEVEN  • YATES-D    • DELAWARE  • PENN BENNETT  • HICH FLOWS, GROUP  • PENN-BENNETT  • TOP OF SEVEN  • YATES/QUEEN    • DEVONIAN  • PENN-BENNETT  • SAN ANDRES, HICH FLOWS, GROUP  • DENN-BENNETT  • SAN ANDRES, HICH FLOWS, GROUP  • TOP OF YATES  • YATES/QUEEN    • ELEVERN  • PENN-BENNETT  • SAN ANDRES, HICH FLOWS, GROUP  • PENN-BENNETT  • SAN ANDRES, HICH FLOWS, GROUP  • TOP OF YATES  • YATES/QUEEN    • ELEVERN  • PENN-BENNETT  • SAN ANDRES, HICH FLOWS, GROUP  • PENNSULVANIAN  • SANDOLON  • TOP OF YATES  • YATES/QUEEN    • DEVONIAN  • PENNSULVANIAN  • SANDOLON  • TOP OF YATES  • YATES		• CH	HERRY CANYON	õ	MCKEE SAND	0	ANHYDRITE	0	TANISLL	0	YATES D	8
o COLBY  COLBY  O GRRIEN  o  SALADO  o  TANSILL  o  YATES G    o COLBY-AUREN  O GRRIEN  o  SALADO SALT  o  TOBORG  VATES SAND    o COLBY-QUEEN  O BRIEN  O SALADO SALT  o  TOBORG  VATES SAND    o DELAWARE  O PENN  SAN ANDRES- HIGH FLOWS, GROUP  O FENN SENNETT  TOP OF SEVEN  VATES JAD    o DEVONIAN  O PENN-BENNETT  H2S, CO  O TOP OF YATES  VATESL    o DEVONIAN  O PENNSULYVANIA  SANA NODELO  O TOP OF VATES  VATESL    o DEVONIAN  O PENNSULYVANIA  SANA VIGELO  O TOP OF VATES  VATESL    o GLORIETA  O PENNSULVANIAN  SANDY LIME  NATES  VATES		CL	EARFORK		MISSISSIDDIAN	0	RUSTLER/SALADO	•	TANSIL	0	YATES F	00
o COLBY SAND  o OBRIEN  o SALADO SALT  o TOPORG  o YATES PAY    o COLBY-QUEEN  o OBRIEN  o SAN ANDRES  o TOP OF QUEEN  o YATES SAND    o DELAWARE  o PENN  o SAN ANDRES  o TOP OF SEVEN  o YATES CAD    o DELAWARE  o PENN ENNETT  SAN ANDRES  o TOP OF SEVEN  o YATES CAD    o DELAWARE  o PENN-ENNETT  HIGH FLOWS, HIGH FLOWS, GROUP  o TOP OF YATES  o YATES CAD    o DEVONIAN  o SAN ANORELO  o TOP OF YATES  o YATES L    o DEVONIAN  o PENNSLYVANIA  o SANA NOBCLO  o TOP QUEEN  o YATES L    o EMPEROR, DEEP  o PENNSLYVANIA  SANDO LUBE  o TOP QUEEN  o YATES    o GLORIETA  o PENNSLYVANIAN  SANDO LUBE  o TOP SEVEN  o YATES		• CC	DLBY	õ		٥	SALADO	۰	TANSILL	0	YATES G	×
o  COLBY-QUEEN  o  SAN ANDRES  o  TOP OF QUEEN  o  YATES SAND    o  DELAWARE  o  PENN  SAN ANDRES  o  TOP OF SEVEN  o  YATES-D    DELAWARE  o  PENN-BENNETT  HIGH FLOWS, GROUP  O  PENN-BENNETT  H2S, CO  o  TOP OF SEVEN  o  YATES-D    o  DEVONIAN  O  PENN-BENNETT  H2S, CO  o  TOP OF QUEEN  o  YATES    o  DEVONIAN  O  PENNS/LYANIA  SANA ANGELO  o  TOP QUEEN  o  YATES    o  EMPEROR, DEEP  O  PENNS/LYANIA  SAND/DOLO  o  TOP SEVEN  o  YATES    o  GLORIETA  O  PENNS/LVANIAN  SAND/ LIME  TOP SEVEN  o  YATES		• CC	OLBY SAND		OBRIEN	0	SALADO SALT	0	TOBORG	0	YATES PAY	· · · · · · · · · · · · · · · · · · ·
• DELAWARE  • PENN  SAN ANDRES.  • TOP OF SEVEN  • YATES:D    • DELAWARE  • PENN BENNETT  • HIGH FLOWS,  RIVERS  • YATES:QUEEN    • ROUP  • PENN-BENNETT  + HIGH FLOWS,  • TOP OF YATES  • YATES:QUEEN    • DEVONIAN  • PENN  • SAN ANGELO  • TOP OUEN  • YATESL    • EMPEROR, DEEP  • PENNSLYVANIA  • SANA NOBLO  • TOP OUEN  • YATESL    • EMPEROR, DEEP  • PENNSLYVANIA  • SAND/DOLO  • TOP SEVEN  • YATESL    • GLORIETA  • PENNSLYVANIAN  • SANDY LIME  • TOP SEVEN  • YATESL		• CC	OLBY-QUEEN		DENN	0	SAN ANDRES	0	TOP OF QUEEN	0	YATES SAND	° 🧏 🖬
DELAWARE      O HIGH FLOWS, GROUP      RIVERS      O YATES/QUEN        0      DEVONIAN      0      PENN-EINST      H2S, CO2      0      TOP OF YATES      VYATES/ O TOP OF YATES        0      DEVONIAN      0      PENN-L      SAN ANGELO      0      TOP QUEEN      VATES        0      EMPEROR, DEEP      0      PENNSLYVANIA      SANADIDOLO      TOP SEVEN      0      YATES        0      GLORIETA      0      PENNSLYVANIAN      SANDY LIME      TOP SEVEN      VATS		DE	ELAWARE		PENN BENNETT		SAN ANDRES -	0	TOP OF SEVEN	0	YATES-D	/
o Devonian  o PENNSLYVANIA  o SAN ANGELO  o TOP OF YATES  o YATESL    o Devonian  o PENNSLYVANIA  o SANDIDOLO  o TOP QUEEN  o YATESL    o EMPEROR, DEEP  o PENNSLYVANIA  o SANDIDOLO  TOP SEVEN  o YATESL    o GLORIETA  o PENNSLVANIAN  o SANDY LIME  TOP SEVEN  o YATESL		DE	ELAWARE	õ	DENN-BENNETT	0	HIGH FLOWS,	•	RIVERS	0	YATES/QUEEN	°** 200
DEVORIAN  O FLOWAL  O SANANGELO  O TOP QUEEN  O YATRES  EMPEROR, DEEP  PENNSLYVANIA  SANDVIDOLO  TOP SEVEN  VATS  RIVERS		GF		Š	PENN-DEINNETT		H2S, CO	0	TOP OF YATES	٥	YATESL	00×0
o GLORIETA O PENNSYLVANIAN O SANUJUDUU O TOP SEVEN O YATS RIVERS			EVUNIAN		PENNSI VVANIA	0	SAN ANGELU	0	TOP QUEEN	0	YATRES	
GLORIEIA GIERROTEVARIA GISANDI LIME RIVERG			ODIETA		PENNSYLVANIAN	0	SANDY LINE	0	TOP SEVEN	0	YATS	×v
		GL			OUEEN	0	SAINDY LIME	•	TOP VATES			

![](_page_16_Figure_3.jpeg)

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## **RRC Class II Well Database & Procedures**

- Latest available data download from RRC
  - October 2020
  - Kept constant throughout the project
  - Updated once before final deliverables?

#### TWDB BRACS MS Access database & scripts

- Access database updated
- Workflow created
- Potential automation
- Analysis of database
  - Identify required attributes for input model
  - Identify Class II wells with missing attributes

![](_page_18_Figure_0.jpeg)

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### 2020 RRC UIC Data Update

UIC Inventory Permit Information UIC Permit Remarks UIC Monitor Information H-10 (Monthly Monitor)

> Information H-10H (Monthly Monitor) Information

> > Monitor Remarks

H-5 (Pressure Testing) Information

H-5 Remarks UIC Enforcement Information Enforcement Action Information Enforcement Action Other Data Enforcement Remarks

H-10H Monitor Annual Information

H-10 Violation Information

	1	2	3	4	5	6	7
1	Table Name:	gClass2InjWell	uif700a_root	uif700a_rmk	uif700a_montr	uif700a_monH10H	uif700a_mon_rmk
2	Dictionary Key (RRC_TAPE_RECORD_ID):	N/A (this table is an assemblage of relevant fields from other existing tables. This is the "primary" table used to create the Class II well shapefile)	01	02	03	04/05	(empty) 06
3	Fields:	API FULL	RRC TAPE RECORD ID	RRC TAPE RECORD ID	RRC TAPE RECORD ID	RRC TAPE RECORD ID	RRC TAPE RECORD ID
4		TYPE INJ	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO
5		INJ ZNE TD	UIC O G TYPE	UIC O G TYPE	UIC O G TYPE	UIC O G TYPE	UIC O G TYPE
6	Legend	INJ ZNE BD	UIC LEASE ID	UIC LEASE ID	UIC LEASE ID	UIC LEASE ID	UIC LEASE ID
7	No highlight indicates table already exists with	T Z BD	UIC DIST	UIC DIST	UIC DIST	UIC DIST	UIC DIST
8	displayed fields in Access database	S Z TD	UIC WELL NO	UIC WELL NO	UIC WELL NO	UIC WELL NO	UIC WELL NO
9	Data exists in .csv file, but has not been analyzed	S Z BD	UIC OPER	UIC API FULL	UIC API FULL	UIC API FULL	UIC API FULL
10	or imported into Access database	ACTIVE	UIC CNTY NO	UIC REMARKS RMK	UIC MONTR W STATUS	MN H10H CCYY	MN REMARKS TYPE
11	•	LETTER DT	UIC API NO	UIC REMARKS LINE	UIC MONTR SW	MN H10H MONTH	MN REMARKS
12		CANCEL DT	UIC API FULL	UIC REMARKS TYPE	UIC MONTR FW	MN H10H MAX HYDROCARB PSIG	
13		W3_DATE	UIC_FIELD_NO	UIC_REMARKS	UIC_MONTR_FRAC_WATER	MN_H10H_MAX_BRINE_PSIG	
14		LATDD	UIC_CLASS	UIC_REMARK_ID	UIC_MONTR_NRM	MN_H10H_INJ_BRINE_BBLS_SIGN	
15		LONGDD	UIC_APPR_DATE	UIC_REMARK_DATE	UIC_MONTR_CO2	MN_H10H_INJ_BRINE_BBLS	
16		INJ_SW	UIC_APPR_CC	UIC_REMARK_CCYY	UIC_MONTR_CO2A	\$MN_H10H_INJ_HYDRO_BBLS_SIGN	
17		INJ_FW	UIC_APPR_YY	UIC_REMARK_MM	UIC_MONTR_GAS	MN_H10H_INJ_HYDROCARB_BBLS	
18		INJ_FRAC_W	UIC_APPR_MONTH	UIC_REMARK_DD	UIC_MONTR_H2S	MN_H10H_INJ_GAS_MCF_SIGN	
19		INJ_NORM	UIC_APPR_DAY		UIC_MONTR_POLYMER	MN_H10H_INJ_GAS_MCF	
20		INJ_CO2	UIC_W14_DATE		UIC_MONTR_STEAM	MN_H10H_DOCUMENT_CYCLE	
21		INJ_GAS	UIC_W14_CC		UIC_MONTR_AIR	MN_H10H_DOCUMENT_BATCH	
22		INJ_H2S	UIC_W14_YY		UIC_MONTR_NITROGEN	MN_H10H_DOCUMENT_ITEM	
23		INJ_POLYM	UIC_W14_MONTH		UIC_MONTR_OTH		
24		INJ_STEAM	UIC_W14_DAY		UIC_MONTR_BW		
25		INJ_AIR	UIC_H1_DATE		UIC_MONTR_LPG		
26		INJ_N	UIC_H1_CC		UIC_MONTR_SW_PCT		
27		INJ_OTHER	UIC_H1_YY		UIC_MONTR_FW_PCT		
28		INJ_BW	UIC_H1_MONTH		UIC_MONTR_FRAC_WATER_PCT		
29		INJ_LPG	UIC_H1_DAY		UIC_MONTR_NORM_PCT		
30		PERF_Z_TD	UIC_LETTER_DATE		UIC_MONTR_CO2_PCT		

<u>ا</u>	8	9	10	11	12	13	14	15
1 Table Name:	uif700a_H5	uif700a_H5_rmk	uif700a_enf	uif700a_enfact	uif700a_enfoth	uif700a_enfrmk	uif700a_mon10H	uif700a_H10vio
Dictionary Key (RRC_TAPE_RECO	RD_ID): 07	08	09	10	11	12	13	14
3 Fields:	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID
4	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO	UIC CNTL NO	UIC_CNTL_NO	UIC CNTL NO	UIC CNTL NO
5	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE	UIC_O_G_TYPE
6 Legend	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID	UIC_LEASE_ID
7 No highlight indicates table already	exists with UIC DIST	UIC DIST	UIC DIST	UIC DIST	UIC DIST	UIC DIST	UIC DIST	UIC DIST
8 displayed fields in Access data	abase UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO	UIC_WELL_NO
9 Data exists in .csv file, but has not bee	en analyzed UIC_API_FULL	UIC_API_FULL	UIC_API_FULL	UIC_API_FULL	UIC_API_FULL	UIC_API_FULL	UIC_API_FULL	UIC_API_FULL
10 or imported into Access datab	base UIC_H5_TEST_DATE_KEY	H5_REMARKS_TYPE	UIC_ENF_KEY	ENF_ACT_VIOL_DATE	ENF_OTH_COMP_METHOD	ENF_REMARKS_TYPE	UIC_H10H_MONTR_KEY	UIC_H10_VIOL_BEGIN_YEAR
11	UIC H5 TEST SEQ NUM	H5 REMARKS	UIC ENF MAN FILE FLAG	ENF ACT VIOL CC	ENF OTH ENFORCE TYPE	ENF_REMARKS	UIC H10H MONTR CC	UIC H10 VIOL BEGIN MONTH
12	UIC_H5_DUE_DATE			ENF_ACT_VIOL_YY	ENF_OTH_COMPLAINT_NUM		UIC_H10H_MONTR_YY	UIC_H10_VIOL_END_YEAR
13	UIC_H5_DUE_CC			ENF_ACT_VIOL_MM			UIC_H10H_MONTR_MM	UIC_H10_VIOL_END_MONTH
14	UIC_H5_DUE_YY			ENF_ACT_VIOL_DD			UIC_H10H_MONTR_W_STATUS	UIC_H10_VIOL_CODE
15	UIC_H5_DUE_MM			ENF_ACT_VIOL_CODE			UIC_H10H_MONTR_CRUDE	UIC_H10_VIOL_LETTER_KEY
16	UIC_H5_DUE_DD			ENF_ACT_NOTICE_DATE			UIC_H10H_MONTR_GAS	UIC_H10_VIOL_LETTER_DATE
17	UIC_H5_RECEIVED_DATE			ENF_ACT_NOTICE_CC			UIC_H10H_MONTR_LPG	UIC_H10_VIOL_LETTER_YEAR
18	UIC_H5_RECEIVED_CC			ENF_ACT_NOTICE_YY			UIC_H10H_MONTR_OTHER	UIC_H10_VIOL_LETTER_MONTH
19	UIC_H5_RECEIVED_YY			ENF_ACT_NOTICE_MM			UIC_H10H_MONTR_PRESS_GT_ZERO	UIC_H10_VIOL_LETTER_DAY
20	UIC_H5_RECEIVED_MM			ENF_ACT_NOTICE_DD			UIC_H10H_MONTR_SURFACE_VESSEL	UIC_H10_VIOL_RESOLVE_DATE
21	UIC_H5_RECEIVED_DD			ENF_ACT_NOTICE_TYPE			UIC_H10H_MONTR_REC_FLG	UIC_H10_VIOL_RESOLVE_YEAR
22	UIC_H5_SCHEDULE_TYPE			ENF_ACT_COMP_DATE			UIC_H10H_MULT_WELL_CAVERN_FLAG	UIC_H10_VIOL_RESOLVE_MONTH
23	UIC_H5_SCHEDULE_FLAG			ENF_ACT_COMP_CC			UIC_H10H_MONTR_ISS_DATE	UIC_H10_VIOL_RESOLVE_DAY
24	UIC_H5_SCHEDULED_DATE			ENF_ACT_COMP_YY			UIC_H10H_MONTR_ISS_CC	UIC_H10_VIOL_RESOLVE_BY_FLAG
25	UIC_H5_SCHEDULED_CC			ENF_ACT_COMP_MM			UIC_H10H_MONTR_ISS_YY	UIC_H10_VIOL_P4_CERT_DTE_KEY
26	UIC_H5_SCHEDULED_YY			ENF_ACT_COMP_DD			UIC_H10H_MONTR_ISS_MM	UIC_H10_VIOL_P4_CERT_SECTION
27	UIC_H5_SCHEDULED_MM			ENF_ACT_COMP_METHOD			UIC_H10H_MONTR_ISS_DD	UIC_H10_VIOL_P4_CERT_REASON
28	UIC_H5_SCHEDULED_DD			ENF_ACT_SNC_FLAG			UIC_H10H_MONTR_REC_DATE	UIC_H10_VIOL_SEVER_LTR_DATE
29	UIC_H5_2ND_NOTICE_DATE			ENF_ACT_VIOL_ON_HOLD			UIC_H10H_MONTR_REC_CC	UIC_H10_VIOL_SEVER_LTR_YEAR
30	UIC H5 2ND NOTICE CC						UIC H10H MONTR REC YY	UIC H10 VIOL SEVER LTR MONTH

### 2020 RRC Well Bore Data Update

Well Bore Technical Data Root Segment Well Bore Completion Information Segment Well Bore Technical Data Forms File Data Well Bore Remarks Segment Well Bore Tubing Segment Well Bore Casing Segment Well Bore Perf Segment Well Bore Liner Segment Well Bore Formation Data Segment Well Bore Squeeze Segment Well Bore Usable Quality Water Protection Well Bore Old Location Segment Well Bore New Location Segment Well Bore Plugging Data Segment Well Bore Plugging Remarks Segment Well Bore Plugging Record Segment Well Bore Plugging Data Casing-Tubing record Well Bore Plugging Perfs Segment Well Bore Plugging Data Nomenclature Segment Well Bore Drilling Permit Number Well Bore Well-ID Segment 14B2 Well Segment H-15 Report Segment H-15 Remark Segment Senate Bill 126 (2-Yr Inactive Program) Segment Well Bore - Drilling Permit Status Segment

	1	2	3	4	5	6	7	8
1	Table Name:	dbf900_01root	dbf900_02compl	dbf900_03date	dbf900_04rmks	dbf900_05tube	dbf900_06case	dbf900_07perf
2	Dictionary Key (RRC_TAPE_RECORD_ID):	01	02	03	04	05	06	07
3	Fields:	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID
4		WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER
5		WB_NXT_AVAIL_SUFFIX	WB_OIL_CODE	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY
6	Legend	WB_NXT_AVAIL_HOLE_CHGE_NBR	WB_OIL_DIST	WB_FILE_DATE	WB_RMK_LNE_CNT	WB_SEGMENT_COUNTER	WB_CASING_COUNT	WB_PERF_COUNT
7	No highlight indicates table already exists with	WB_FIELD_DISTRICT	WB_OIL_LSE_NBR	WB_EXCEPT_RULE_11	WB_RMK_TYPE_CODE	WB_TUBING_INCHES	WB_CAS_INCH	WB_FROM_PERF
8	displayed fields in Access database	WB_RES_CNTY_CODE	WB_OIL_WELL_NBR	WB_CEMENT_AFFIDAVIT	WB_REMARKS	WB_FR_NUMERATOR	WB_CAS_FRAC_NUM	WB_TO_PERF
9	Data exists in .csv file, but has not been	WB_ORIG_COMPL_CC	WB_GAS_CODE	WB_G_5		WB_FR_DENOMINATOR	WB_CAS_FRAC_DENOM	WB_OPEN_HOLE_CODE
10	analyzed or imported into Access database	WB_ORIG_COMPL_DATE	WB_GAS_RRC_ID	WB_W_12		WB_DEPTH_SET	WB_CAS_WT_TABLE	
11		WB_ORIG_COMPL_CENT	WB_GAS_DIST	WB_DIR_SURVEY		WB_PACKER_SET	WB_WGT_WHOLE1	
12		WB_ORIG_COMPL_YY	WB_GAS_WELL_NO	WB_W2_G1_DATE			WB_WGT_TENTHS1	
13		WB_ORIG_COMPL_MM	WB_MULTI_WELL_REC_NBR	WB_COMPL_DATE			WB_WGT_WHOLE2	
14		WB_ORIG_COMPL_DD	WB_API_SUFFIX	WB_COMPL_CENTURY			WB_WGT_TENTHS2	
15		WB_TOTAL_DEPTH	WB_ACTIVE_INACTIVE_CODE	WB_COMPL_YEAR			WB_CASING_DEPTH_SET	
16		WB_VALID_FLUID_LEVEL	WB_DWN_HOLE_COMMINGLE_CODE	WB_COMPL_MONTH			WB_MLTI_STG_TOOL_DPTH	
17		WB_CERT_REVOKED_DATE	WB_CREATED_FROM_PI_FLAG	WB_COMPL_DAY			WB_AMOUNT_OF_CEMENT	
18		WB_CERT_REVOKED_CC	WB_RULE_37_NBR	WB_DRL_COMPL_DATE			WB_CEMENT_MEASUREMENT	
19		WB_CERT_REVOKED_YY	WB_P_15	WB_PLUGB_DEPTH1			WB_HOLE_INCH	
20		WB_CERT_REVOKED_MM	WB_P_12	WB_PLUGB_DEPTH2			WB_HOLE_FRAC_NUM	
21		WB_CERT_REVOKED_DD	WB_PLUG_DATE_POINTER	WB_WATER_INJECTION_NBR			WB_HOLE_FRAC_DENOM	
22		WB_CERTIFICATION_DENIAL_DATE		WB_SALT_WTR_NBR			WB_TOP_OF_CEMENT_CASING	
23		WB_CERTIFICATION_DENIAL_CC		WB_REMARKS_IND			WB_AMOUNT_CASING_LEFT	
24		WB_CERTIFICATION_DENIAL_YY		WB_ELEVATION				
25		WB_CERTIFICATION_DENIAL_MM		WB_ELEVATION_CODE				
26		WB_CERTIFICATION_DENIAL_DD		WB_LOG_FILE_RBA				
27		WB_DENIAL_REASON_FLAG		WB_DOCKET_NBR				
28		WB_ERROR_API_ASSIGN_CODE						
29		WB_REFER_CORRECT_API_NBR						
30		WB_DUMMY_API_NUMBER						
31		WB_DATE_DUMMY_REPLACED						
32		WB_NEWEST_DRL_PMT_NBR						
33		WB_CANCEL_EXPIRE_CODE						
34		WB_EXCEPT_13_A						
35		WB_FRESH_WATER_FLAG						

1	9	10	11	12	13	14	15
1 Table Name:	dbf900_08line	dbf900_09form	dbf900_10sqeze	dbf900_11fresh	dbf900_12oldloc	dbf900_13newloc	dbf900_14plug
2 Dictionary Key (RRC_TAPE_RECORD_ID):	08	09	10	11	12	13	14
3 Fields:	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID	RRC_TAPE_RECORD_ID
4	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER
5	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_LEASE_NAME	WB_LOC_COUNTY	WB_DATE_W3_FILED
6 Legend	WB_LINE_COUNT	WB_FORMATION_CNTR	WB_SQUEEZE_CNTR	WB_FRESH_WATER_CNTR	WB_SEC_BLK_SURVEY_LOC	WB_ABSTRACT	WB_DATE_WELL_BORE_PLUGGED
7 No highlight indicates table already exists with	WB_LIN_INCH	WB_FORMATION_NAME	WB_SQUEEZE_UPPER_DEPTH	WB_TWDB_DATE	WB_WELL_LOC_MILES	WB_SURVEY	WB_PLUG_TOTAL_DEPTH
8 displayed fields in Access database	WB_LIN_FRAC_NUM	WB_FORMATION_DEPTH	WB_SQUEEZE_LOWER_DEPTH	WB_SURFACE_CASING_DETER_CODE	WB_WELL_LOC_DIRECTION	WB_BLOCK_NUMBER	WB_PLUG_CEMENT_COMP
9 Data exists in .csv file, but has not been	WB_LIN_FRAC_DENOM		WB_SQUEEZE_KIND_AMOUNT	WB_UQWP_FROM	WB_WELL_LOC_NEAREST_TOWN	WB_SECTION	WB_PLUG_MUD_FILLED
10 analyzed or imported into Access database	WB_SACKS_OF_CEMENT			WB_UQWP_TO	WB_DIST_FROM_SURVEY_LINES	WB_ALT_SECTION	WB_PLUG_MUD_APPLIED
11	WB_TOP_OF_LINER				WB_DIST_DIRECT_NEAR_WELL	WB_ALT_ABSTRACT	WB_PLUG_MUD_WEIGHT
12	WB_BOTTOM_OF_LINER					WB_FEET_FROM_SUR_SECT_1	WB_PLUG_DRIL_PERM_DATE
13						WB_DIREC_FROM_SUR_SECT_1	WB_PLUG_DRIL_PERM_NO
14						WB_FEET_FROM_SUR_SECT_2	WB_PLUG_DRIL_COMP_DATE
15						WB_DIREC_FROM_SUR_SECT_2	WB_PLUG_LOG_ATTACHED
16						WB_WGS84_LATITUDE	WB_PLUG_LOG_RELEASED_TO
17						WB_WGS84_LONGITUDE	WB_PLUG_TYPE_LOG
18						WB_PLANE_ZONE	WB_PLUG_FRESH_WATER_DEPTH
19						WB_PLANE_COORDINATE_EAST	WB_PLUG_FROM_UWQP_1
20						WB_PLANE_COORDINATE_NORTH	WB_PLUG_TO_UWQP_1
21						WB_VERIFICATION_FLAG	WB_PLUG_FROM_UWQP_2
22							WB_PLUG_TO_UWQP_2
23							WB_PLUG_FROM_UWQP_3
24							WB_PLUG_TO_UWQP_3
25							WB_PLUG_FROM_UWQP_4
26							WB_PLUG_TO_UWQP_4
27							WB_PLUG_MATERIAL_LEFT
28							WB_PLUG_OIL_CODE
29							WB_PLUG_OIL_DIST
30							WB_PLUG_OIL_LSE_NBR
31							WB_PLUG_OIL_WELL_NBR
32							WB_PLUG_GAS_CODE
33							WB_PLUG_GAS_RRC_ID
34							WB_PLUG_GAS_DIST
35							WB_PLUG_GAS_WELL_NO

## **Modeling Techniques & Tools**

- link to database from Aquifer Assessment task
- identify the lateral and vertical impact of injection wells within aquifers
- procedures and tools:
  - appropriate analytical/numerical solution
  - map the impact
  - visualization & documentation

### **Modeling Approach**

- Aquifer Assessment database
  - location,
  - aquifer parameters
  - injection well parameters
- Preliminary analysis
  - simplifying assumptions
  - 'radius of influence'
  - flag zones for a detailed analysis:
    - impact greater than the default buffer of 15 miles?
    - exceed 'threshold' injectate density?
    - exhibit potential boundary impacts?
    - other?
- detailed analysis for flagged zones

### **Conceptual Modeling: Example**

- Confined aquifer
- Well considerations:
  - Fully-penetrating
  - Partially-penetrating
  - Long-screen: multiple aquifers
  - Long-screen: aquifer stratification within thick aquifers
- Solution considerations:
  - Steady-state
  - Transient
  - Transient with wellbore storage

![](_page_23_Figure_11.jpeg)

Fully-penetrating well Partially-penetrating well

### **Modeling: Preliminary Analysis Examples**

![](_page_24_Figure_1.jpeg)

Solution	Fully-penetrating well	Partially-penetrating well
Steady-state	Thiem (1906)	Javandel (1982); Faybishenko et al (1995)
Transient	Theis (1935); Cooper and Jacob (1946)	Hantush (1961)
Transient with wellbore storage	Papadopulos and Cooper (1667)	Dougherty and Babu (1984)

### **Modeling: Advanced Analysis Examples**

- AEM Methods
  - TTIM
  - TimML
- Axisymmetric model
  *MODFLOW 6*
- Other

# **Q** & **A**

- WSP questions for Workgroup
  - Suggestions
- Next workgroup meeting