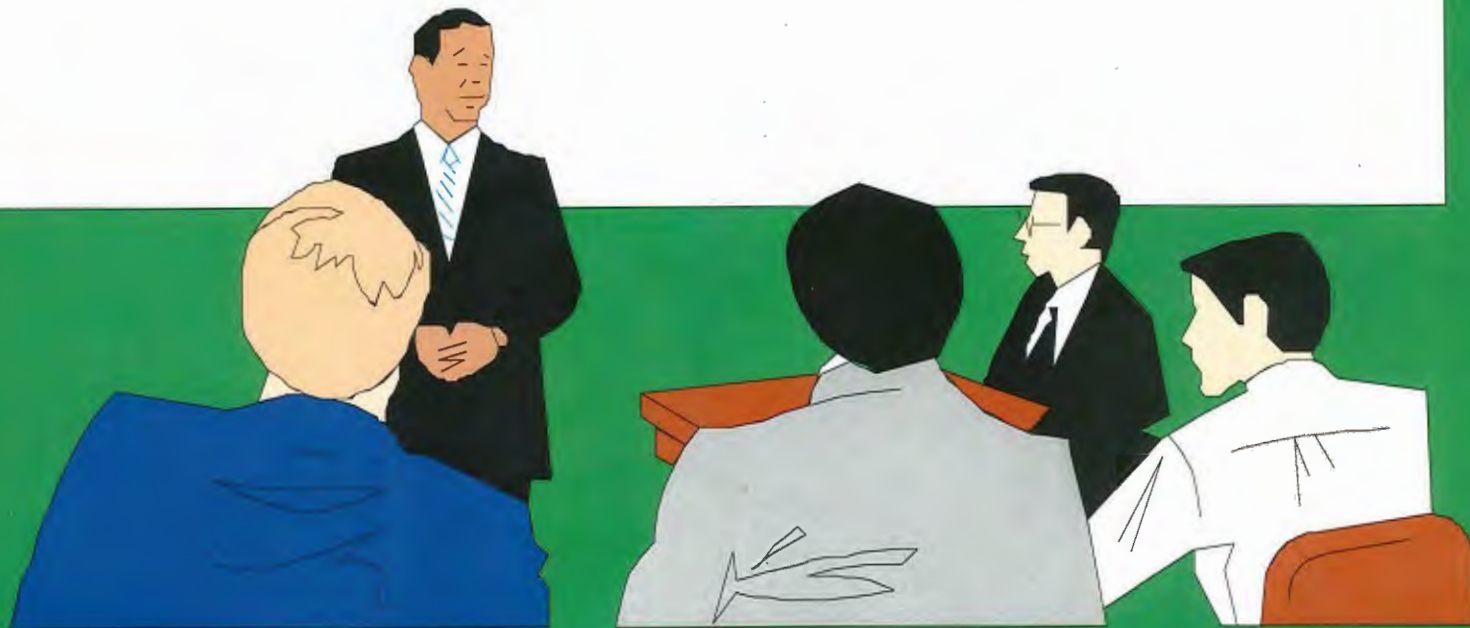


# **New Business Agenda Item 2 (a) -**



# **Aquifer Storage and Recovery Systems**

**Background**

1985 - ASR projects in 3 states



1995 - ASR projects in 8 states






2001  
ASR operational in 15 states  
ASR pilot testing in 5 more states



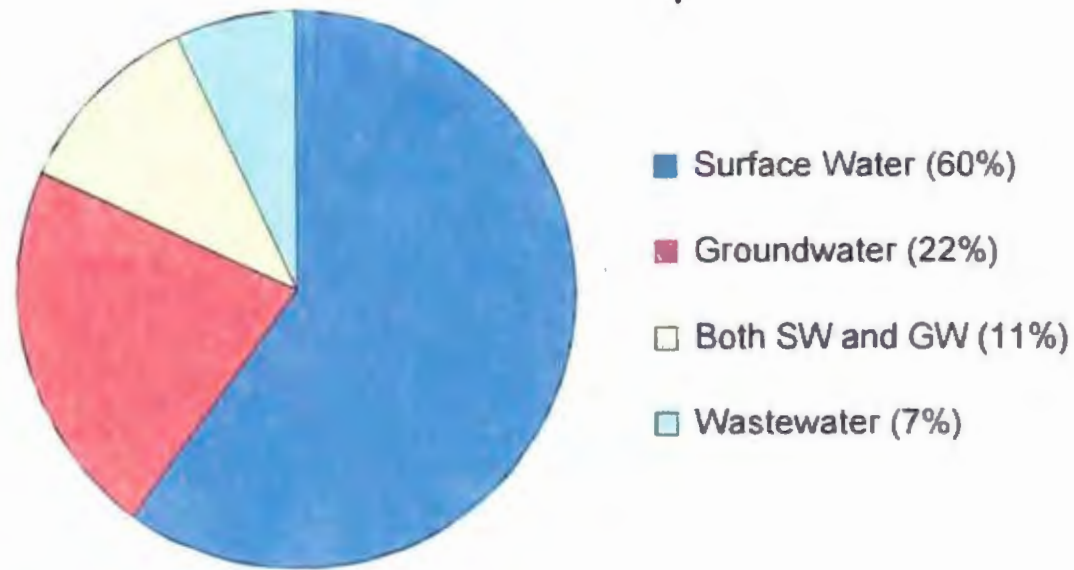
States with ASR in Operation  
States with ASR with Pilot Programs Only

Figure 1.3 Growth of Aquifer Storage and Recovery in the United States



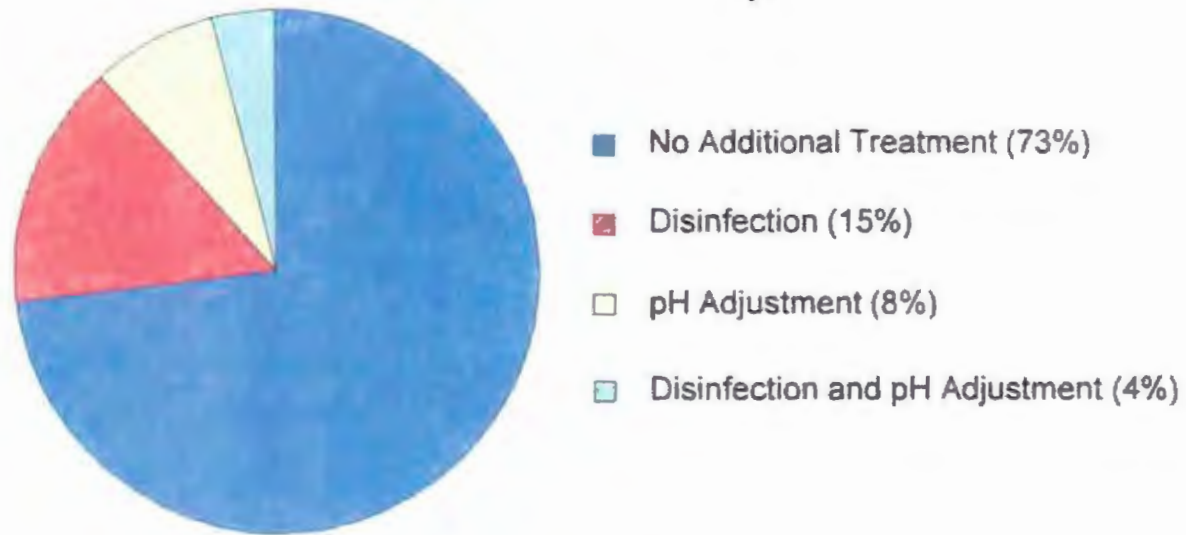
-  States with Feasibility Studies underway
-  States with ASR projects undergoing pilot testing
-  States with operational ASR projects

**Figure 3.1** 2001 Status of Aquifer Storage and Recovery in the United States



**Figure 3.4** Source Water of Aquifer Storage and Recovery Systems





**Figure 3.5** Pre-Injection Treatment Methods at Potable Water Aquifer Storage and Recovery Systems (beyond current treatment – i.e., if potable water is being injected, amount of additional treatment required).

**Aquifer Storage and Recovery  
Well Applications  
45567, 45568 and 45576**

**Staff Review**

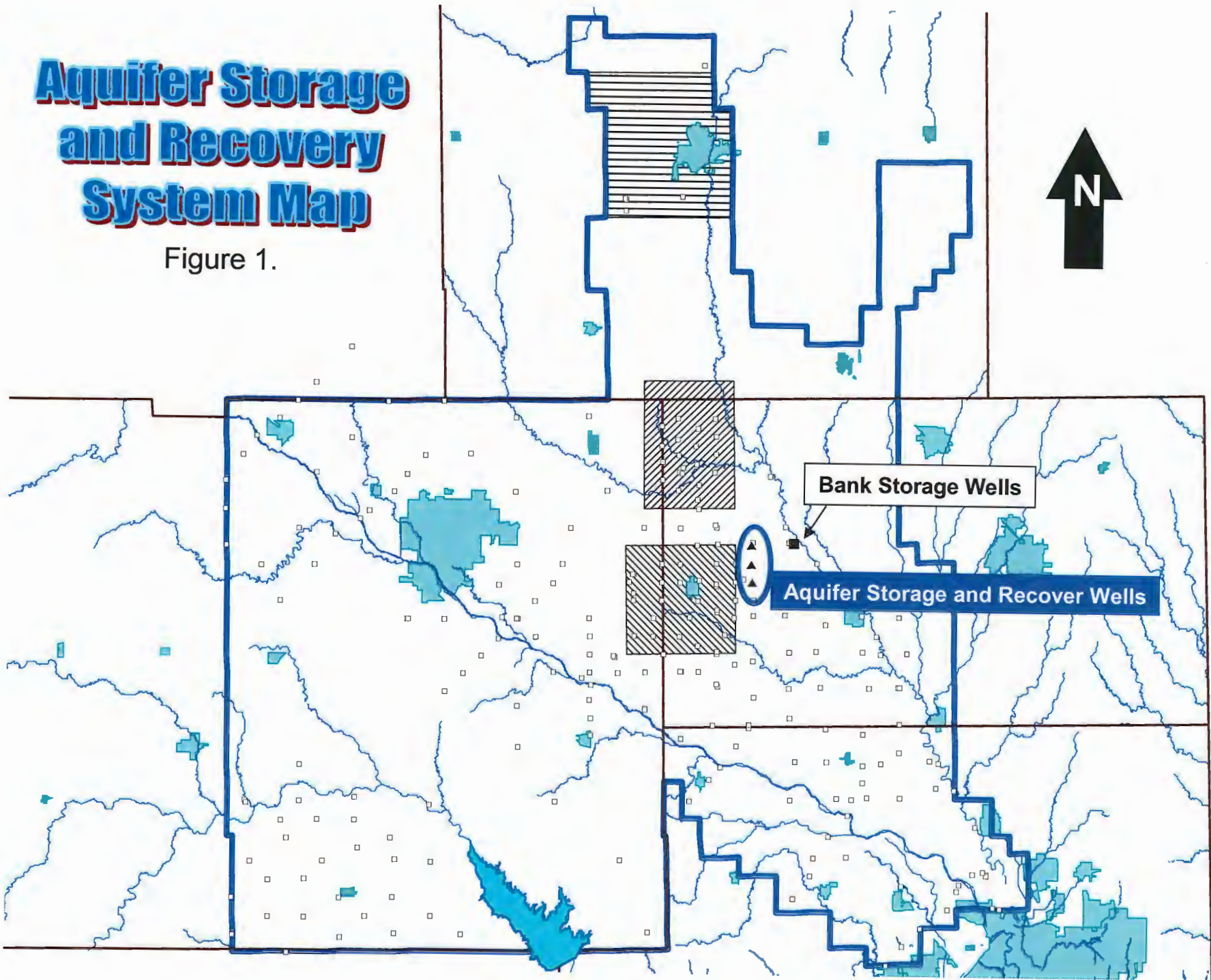
# **Aquifer Storage and Recovery Well Applications 45567, 45568 and 45576**

**The applications were filed for three aquifer storage and recovery wells for the City of Wichita's Aquifer Storage and Recovery system. The applicant proposes to recharge water to the Equus Beds aquifer through the wells for aquifer storage and recovery. The recharged water shall be diverted from the same well to be utilized for municipal use at a later time.**

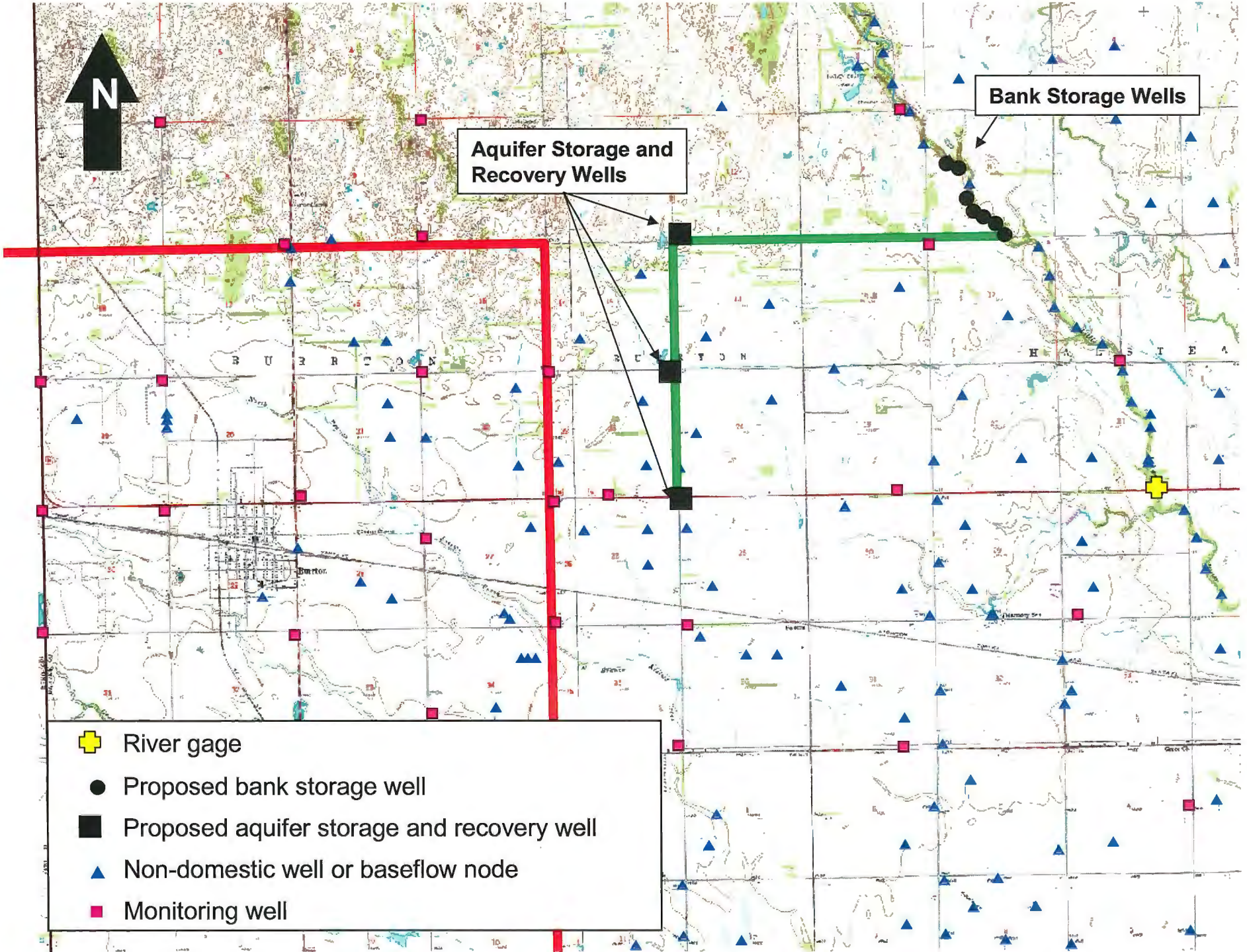


# Aquifer Storage and Recovery System Map

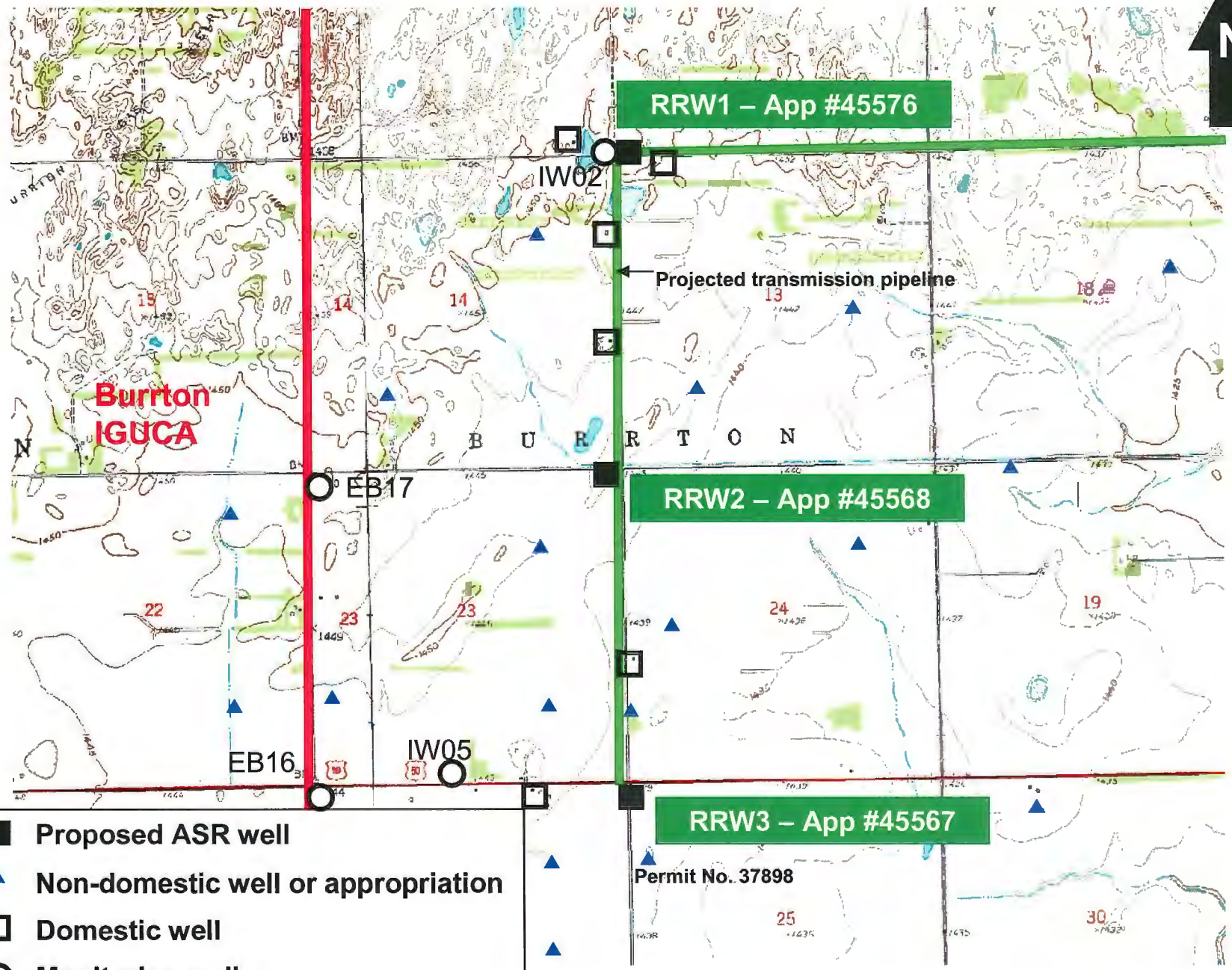
Figure 1.



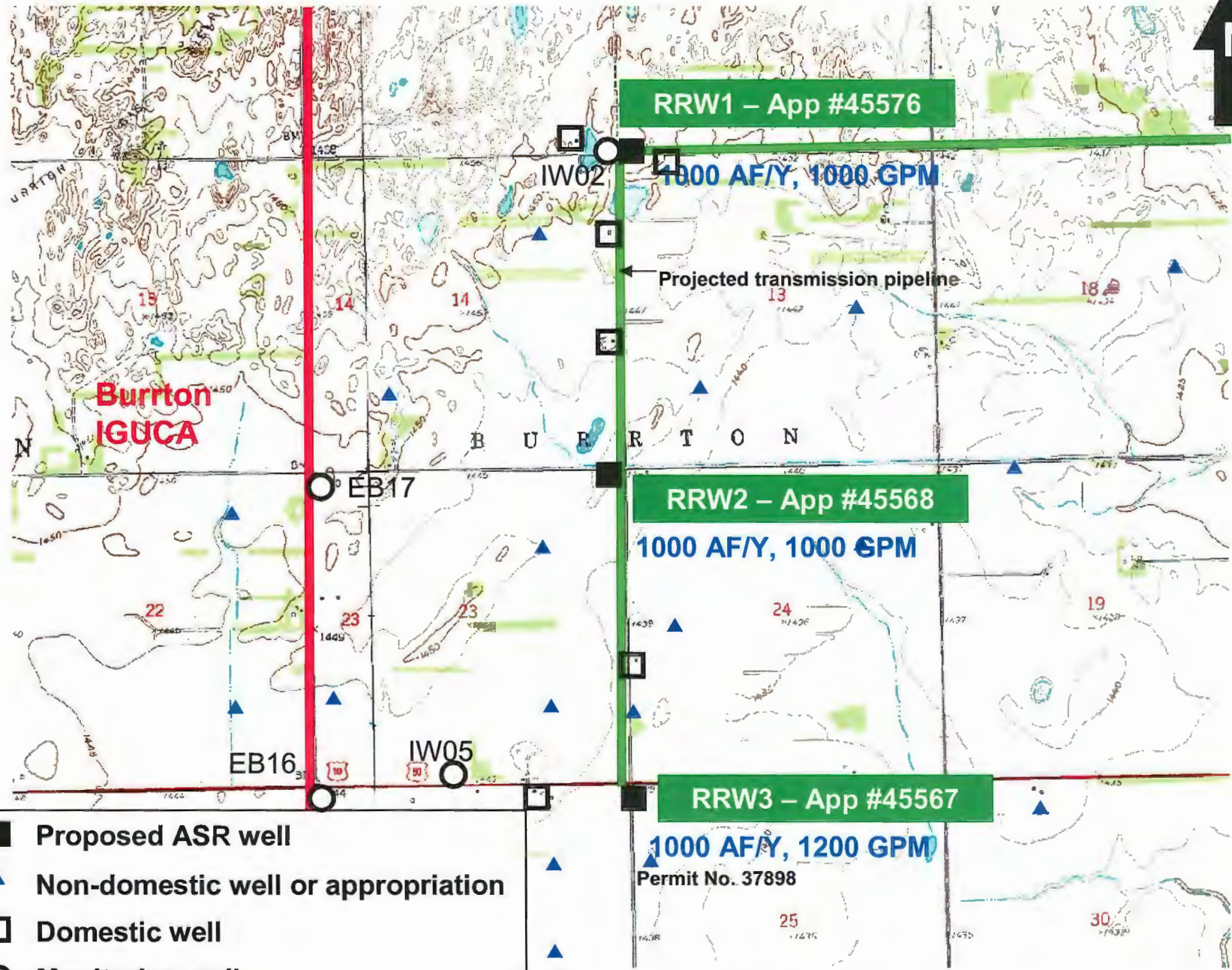












**RRW1 – App #45576**

**1000 AF/Y, 1000 GPM**

**Projected transmission pipeline**

**RRW2 – App #45568**

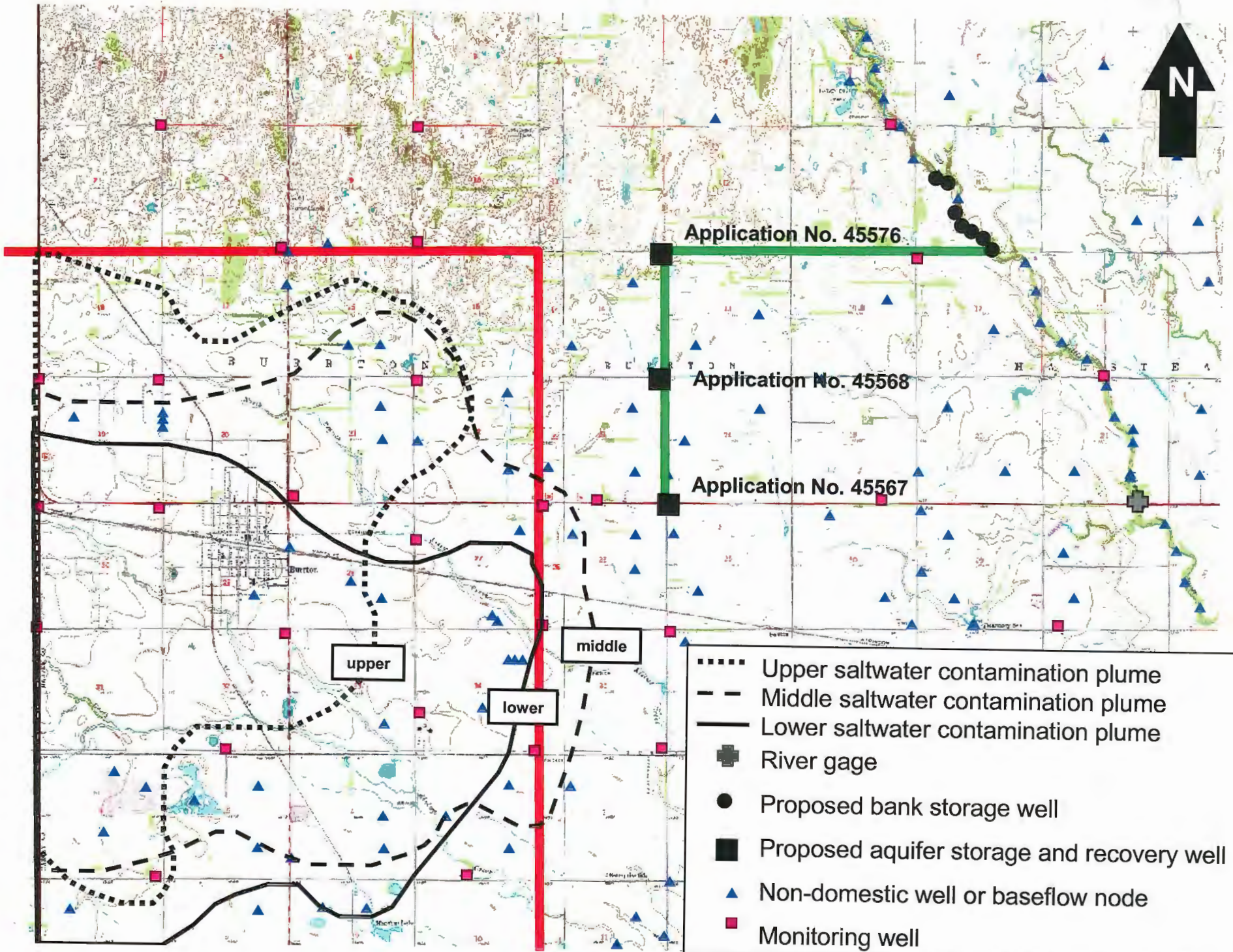
**1000 AF/Y, 1000 GPM**

**RRW3 – App #45567**

**1000 AF/Y, 1200 GPM**  
Permit No. 37898

- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well





Application No. 45566

Application No. 45568

Application No. 45567

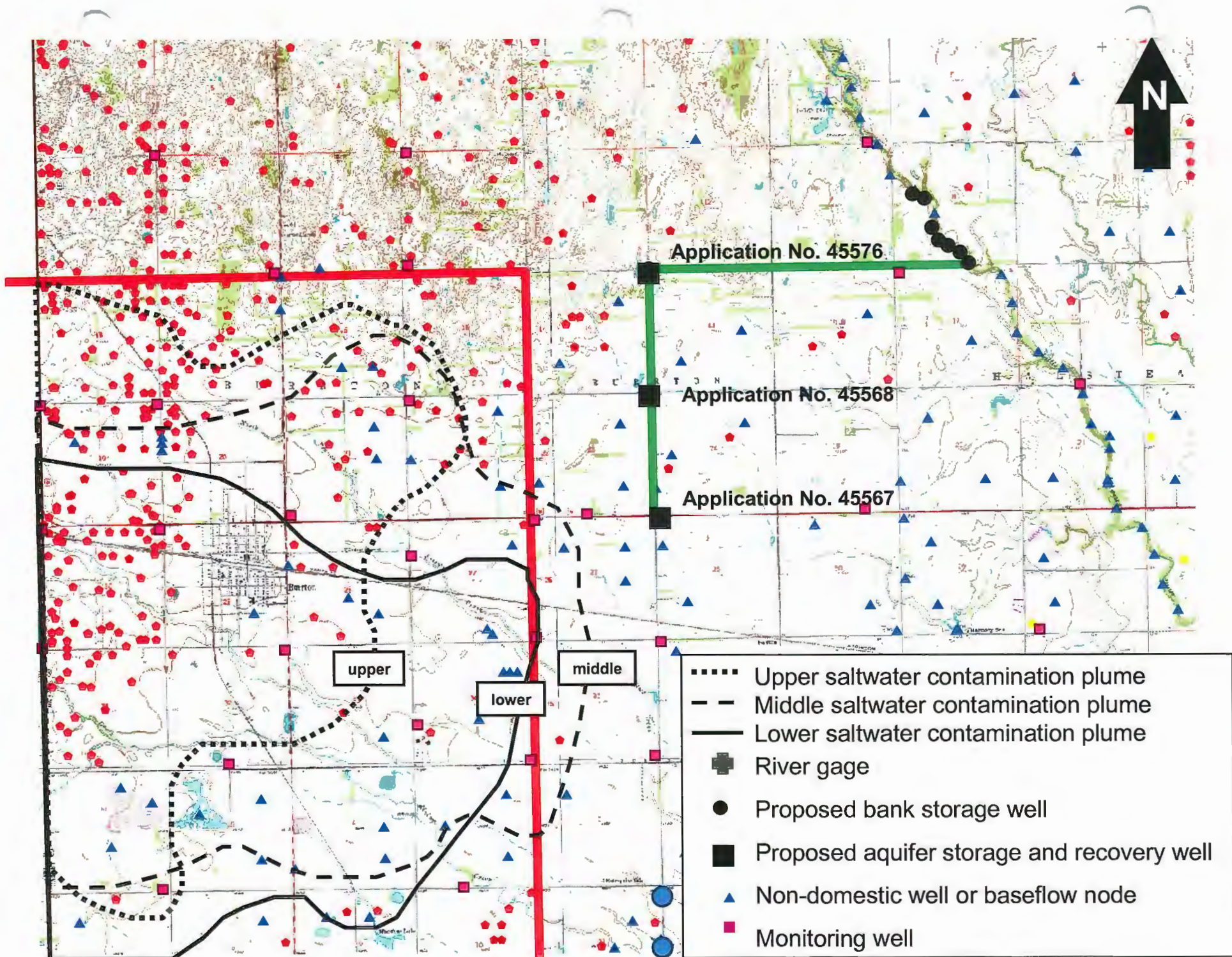
upper

middle

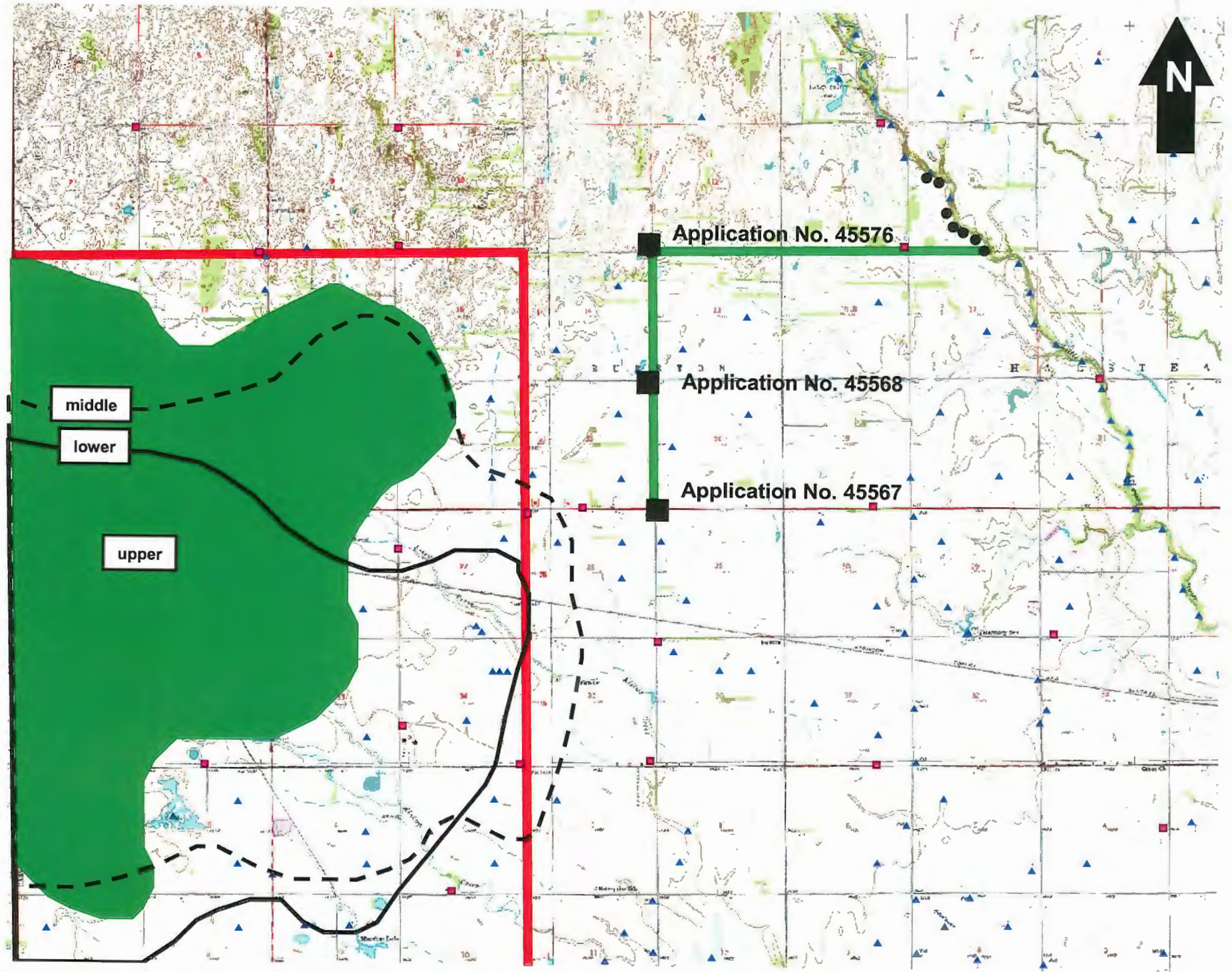
lower

- ..... Upper saltwater contamination plume
- - - Middle saltwater contamination plume
- Lower saltwater contamination plume
- ⊕ River gage
- Proposed bank storage well
- Proposed aquifer storage and recovery well
- ▲ Non-domestic well or baseflow node
- Monitoring well









Application No. 45576

Application No. 45568

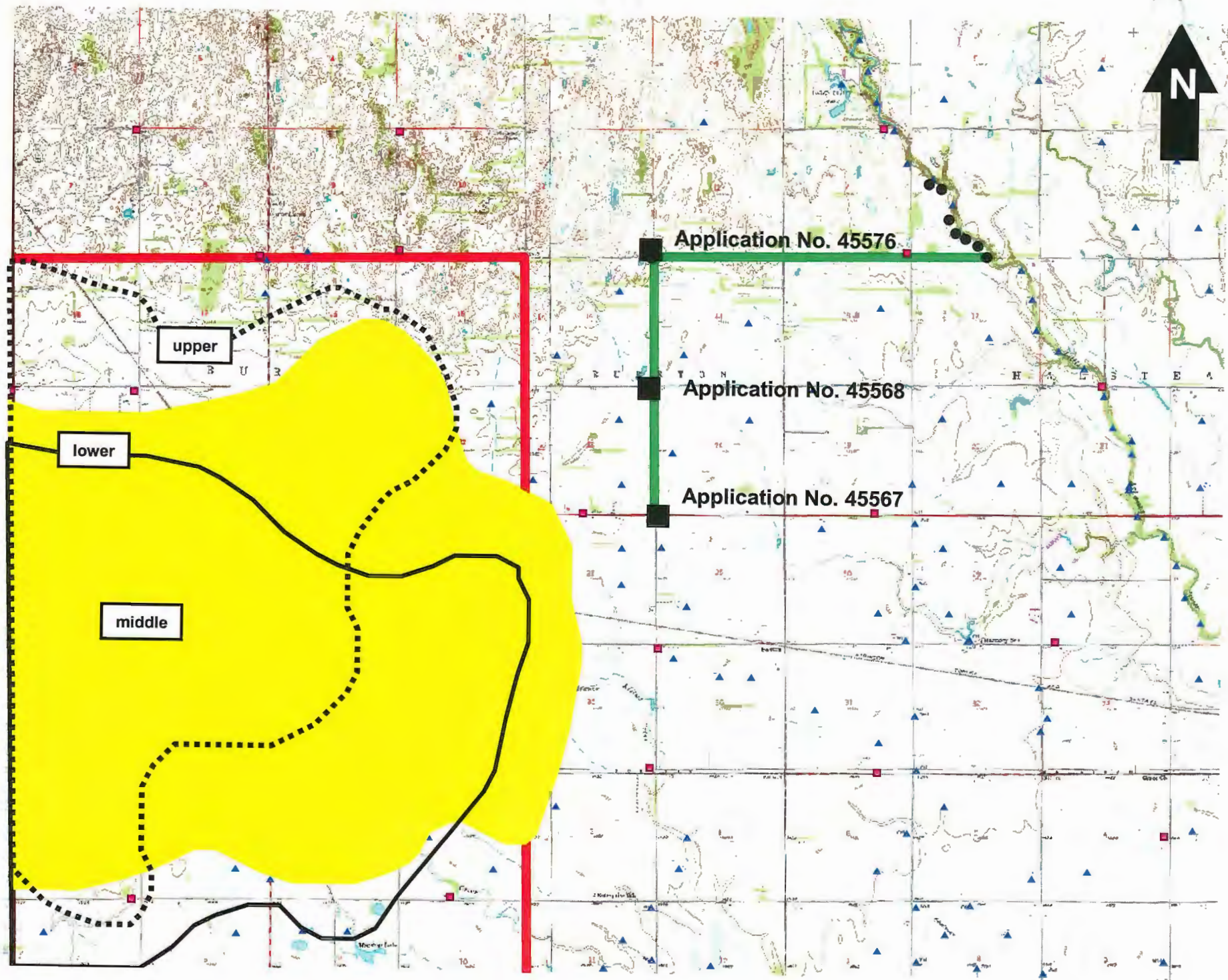
Application No. 45567

middle

lower

upper





upper

lower

middle

Application No. 45576

Application No. 45568

Application No. 45567

1000

H E S T E A

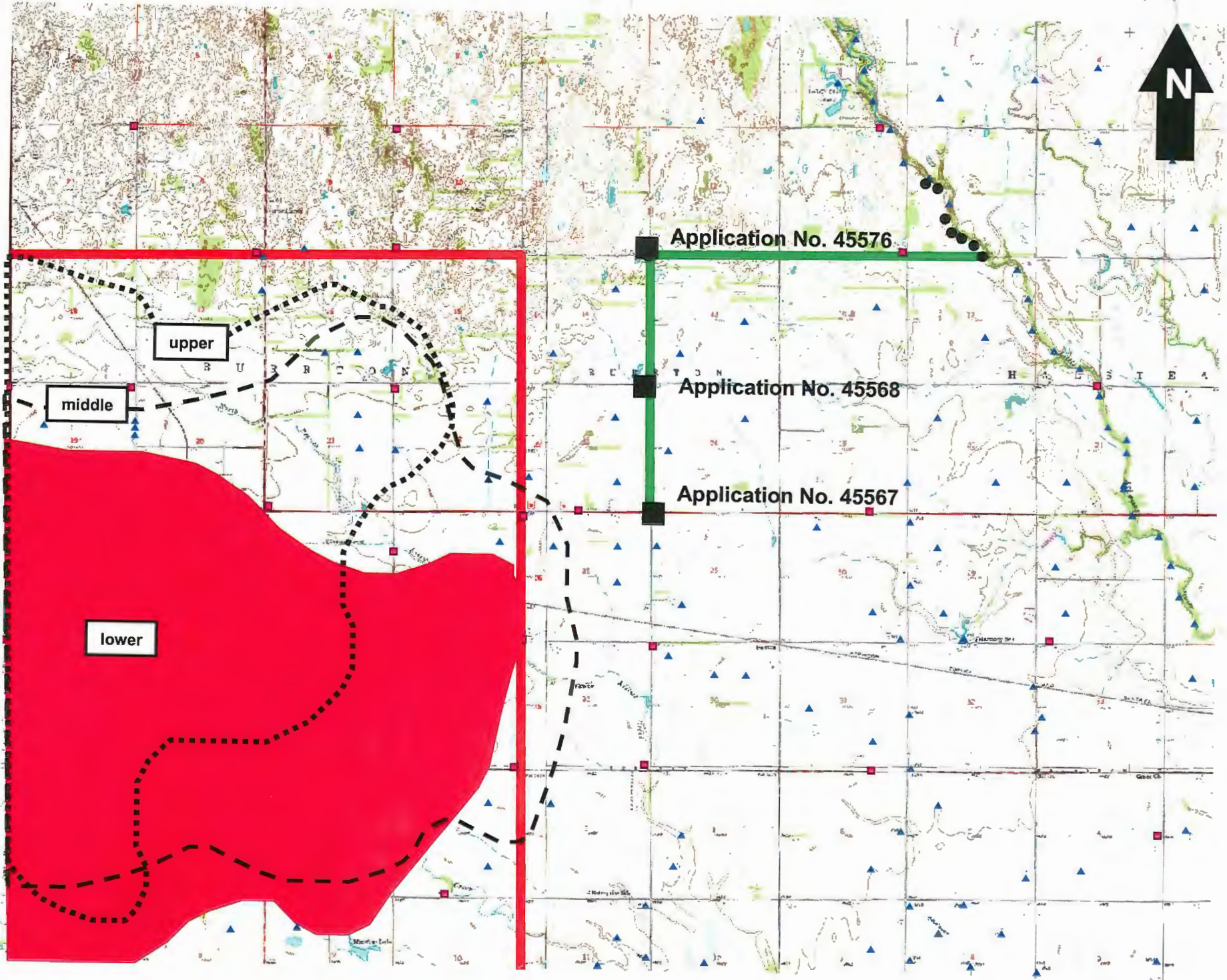
1000

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1000





upper

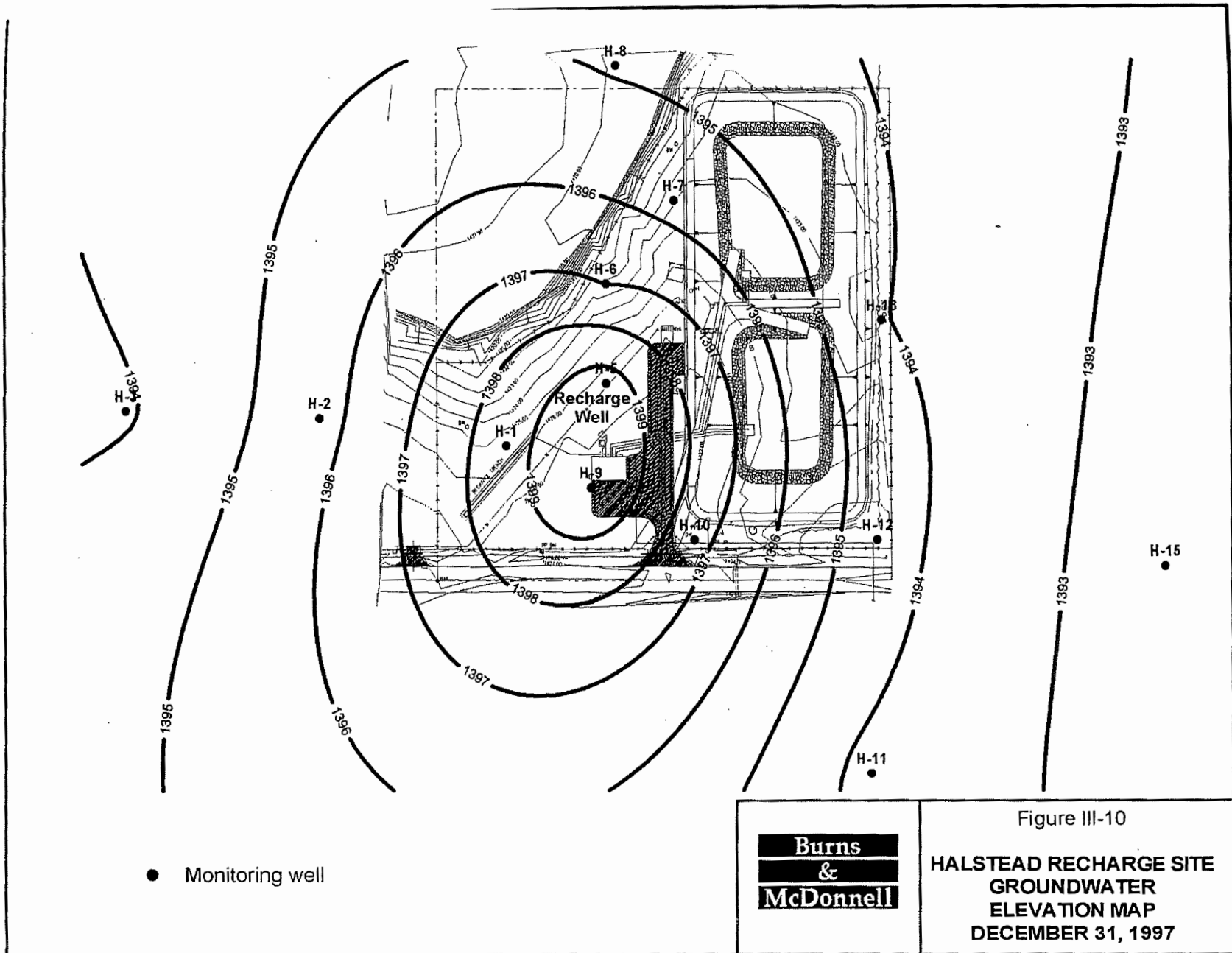
middle

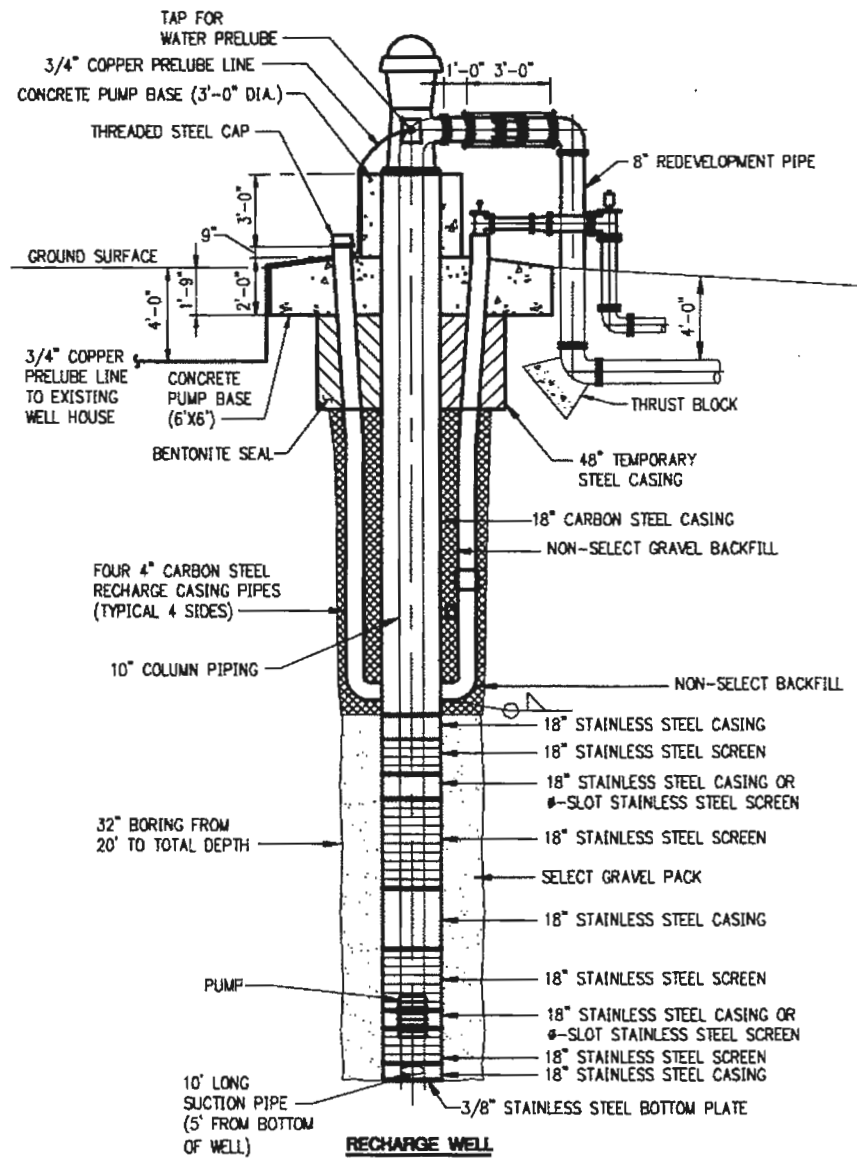
lower

Application No. 45576

Application No. 45568

Application No. 45567





**Figure 9. –  
 Example of  
 Construction  
 Design for  
 Recharge and  
 Recovery Well**



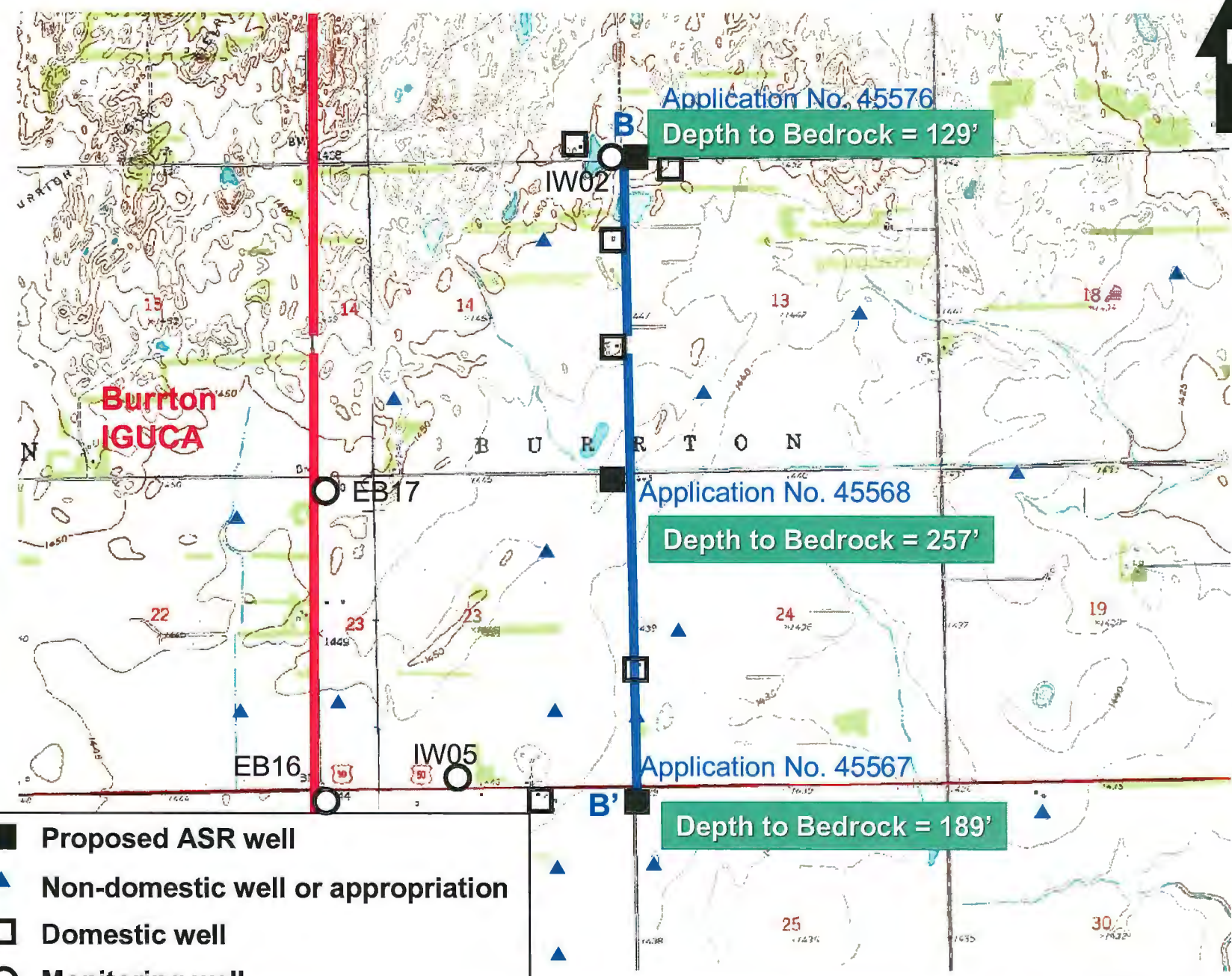
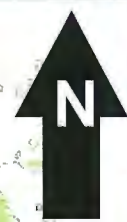
Image source - Equus Beds Groundwater Management District No. 2  
Take by - MT Dealy  
Date - 11 Oct 97  
Subject - Halstead Recharge Facilities





**Aquifer Storage and Recovery  
Well Applications  
45567, 45568 and 45576**

**Site Geohydrology**



- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well

**1 LOCATION OF WATER WELL:** Fraction: NW 1<sup>st</sup> NW 24<sup>th</sup> NW 24<sup>th</sup> Section Number: 25 Township Number: T 23 S 6 Range Number: R 3 E W

County: Harvey Distance and direction from nearest town or city street address of well if located within city? Approximately 3 miles east of Burdon

**2 WATER WELL OWNER:** City of Wichita RRA, SL Address, Box #: 455 N, Main Board of Agriculture, Division of Water Resources City, State, ZIP Code: Wichita, KS 67202 Application Number:

**3 LOCATE WELL'S LOCATION WITHIN AN "X" IN SECTION BOX:**

**4 DEPTH OF COMPLETED WELL:** 191 ft. ELEVATION: Unknown

Depth(s) Groundwater Encountered: I 30.15 ft. below land surface measured on m/d/y/r 11-12-02 II 2 III 3

WELL'S STATIC WATER LEVEL: 30.15 ft. below land surface measured on m/d/y/r 11-12-02

Pump test data: Well water was Not checked ft. after hours pumping gpm

Est. Yield UNKNOWN gpm: Well water was ft. after hours pumping gpm

Bore Hole Diameter: 6 in. to 200 ft. and in. to ft.

WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well  
1 Domestic 3 Foodst 6 Oil field water supply 9 Dewatering 12 Other (specify below)  
2 Irrigation 4 Industrial 7 Domestic (lawn & garden) 10 Monitoring well

Was a chemical/bacteriological sample submitted to Department? Yes No  If yes, m/d/y/r's sample was submitted Water Well Disinfected? Yes No

**5 TYPE OF BLANK CASING USED:** 1 Steel 2 PVC 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)

CASING JOINTS: Glued  Clamped Welded Threaded

Blank casing diameter: 2 in. to 169 ft. Dia. Casing height above land surface: 24 in., weight: .96 lbs./ft. Well thickness or gauge No: 214

**TYPE OF SCREEN OR PERFORATION MATERIAL:** 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

**SCREEN OR PERFORATION OPENINGS ARE:** 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) 11 None (open hole)

**SCREEN-PERFORATED INTERVALS:** From 169 ft. to 189 ft. From 164 ft. to 200 ft.

**GRAVEL PACK INTERVALS:** From 164 ft. to 200 ft.

**6 GROUT MATERIAL:** 1 Neat cement 2 Cement grout 3 Bentonite 4 Other Bentonite Hydrogel

Grout intervals: From 0 ft. to 164 ft.

What is the nearest source of possible contamination:  
1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Sump/pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) None known

Direction from well? How many feet?

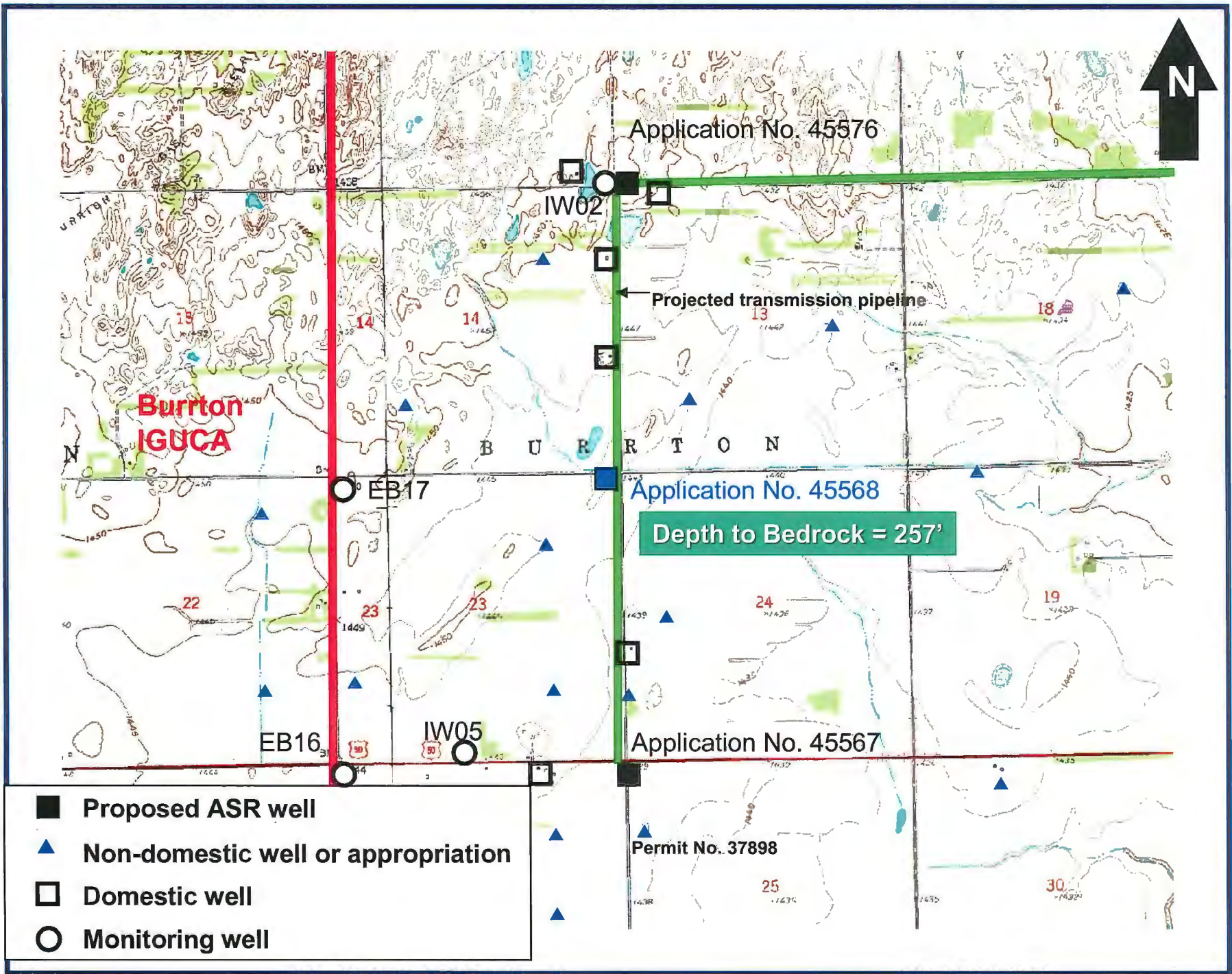
FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	6	Topsoil	168	189	Sand, very fine to coarse with gravel, fine and clay streaks
6	13	Clay, light gray			
13	22	Sand, medium to fine with gravel, medium to fine	189	200	Shale, black
22	33	Clay, brown			
33	47	Sand, very fine to medium, gravel, medium to fine			
47	59	Clay, gray, green			
59	61	Sand, fine to medium, gravel, fine to medium			
61	73	Clay, green			
73	83	Sand, very fine to medium with gravel, fine to medium			
83	101	Clay, gray, green			
101	114	Sand, coarse to very fine with gravel, medium to fine			
114	116	Clay, green			
116	151	Sand, coarse to very fine with gravel, fine to medium			
151	168	Clay, green			

**7 CONTRACTORS OR LANDOWNERS CERTIFICATION:** This water well was (1) constructed (2) reconstructed or (3) plugged under my jurisdiction and was completed on (m/d/y/r) 11-12-02 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 185 This Water Well Record was completed on (m/d/y/r) 11-22-02 under the business name of Clarke Well & Equipment, Inc. by (signature)

**INSTRUCTIONS:** Use speller or ball point pen. PLEASE PRESS HEAVILY and PRINT clearly. Please fill in blanks, underline or circle the correct answer. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66603-0201. Telephone 785-226-5234. Send one to WATER WELL OWNER and keep one for your records. Fee of \$5.00 for each constructed well.

Figure 7. – Application No. 45567 Lithologic Log for Test Well at Proposed ASR Well Site







**1 LOCATION OF WATER WELL:** Fraction Section Number Township Number Range Number  
 County: Harvey NE 1/4 NE 1/4 NE 1/4 23 T 23 S R 3 E W

Distance and direction from nearest town or city street address of well if located within city?  
 Approximately 1 mile north and 3 miles east of Burton

**2 WATER WELL OWNER:** City of Wichita  
 RR, St. Address, Box #: 455 N. Main Board of Agriculture, Division of Water Resources  
 City, State, ZIP Code: Wichita, KS 67202 Application Number:

**3 LOCATE WELL'S LOCATION WITHIN AN "X" IN SECTION BOX:**

**4 DEPTH OF COMPLETED WELL:** 255 ft. **ELEVATION:** unknown  
 Depth(s) Groundwater Encountered: 1 ft. 2 ft. 3 ft. e.  
 WELL'S STATIC WATER LEVEL: not checked ft. below land surface measured on (m/d/yr)  
 Pump test date: Well water was: not checked ft. after hours pumping gpm  
 Est. Yield: unknown gpm: Well water was: ft. after hours pumping gpm  
 Bore Hole Diameter: 6 in. to 265 ft. and in. to ft.  
 WELL WATER TO BE USED AS:  
 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Domestic (lawn & garden) 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (specify below)  
 Was a chemical/bacteriological sample submitted to Department? Yes No  If yes, m/d/yr: sample was submitted Water Well Disinfected? Yes No

**5 TYPE OF BLANK CASING USED:**  
 1 Steel 2 PVC 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)  
 Blank casing diameter: 2 in. to 233 ft. Dia in. to ft. Dia in. to ft.  
 Casing height above land surface: 24 in. weight: 96 lbs./ft. Wall thickness or gauge No: 214  
**CASING JOINTS:** Gued  Clamped  Welded  Threaded

**TYPE OF SCREEN OR PERFORATION MATERIAL:**  
 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC 8 RMP (SR) 9 ADS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)  
**SCREEN OR PERFORATION OPENINGS ARE:**  
 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch-out 8 Saw cut 9 Oozed holes 10 Other (specify) 11 None (open hole)  
**SCREEN-PERFORATED INTERVALS:** From 233 ft. to 253 ft. From ft. to ft. From ft. to ft. From ft. to ft.  
**GRAVEL PACK INTERVALS:** From 225 ft. to 265 ft. From ft. to ft. From ft. to ft. From ft. to ft.

**6 GROUT MATERIAL:** 1 Neat cement 2 Cement grout 3 Bentonite 4 Other Bentonite Holeplug  
 Grout intervals: From ft. to ft. From ft. to ft. From ft. to ft. From ft. to 225 ft.  
 What is the nearest source of possible contamination:  
 1 Septic tank 2 Sewer lines 3 Wastewater sewer lines 4 Lateral lines 5 Cess pool 6 Sewage pit 7 Pit/pit 8 Sewage lagoon 9 Foodyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) 17 None known

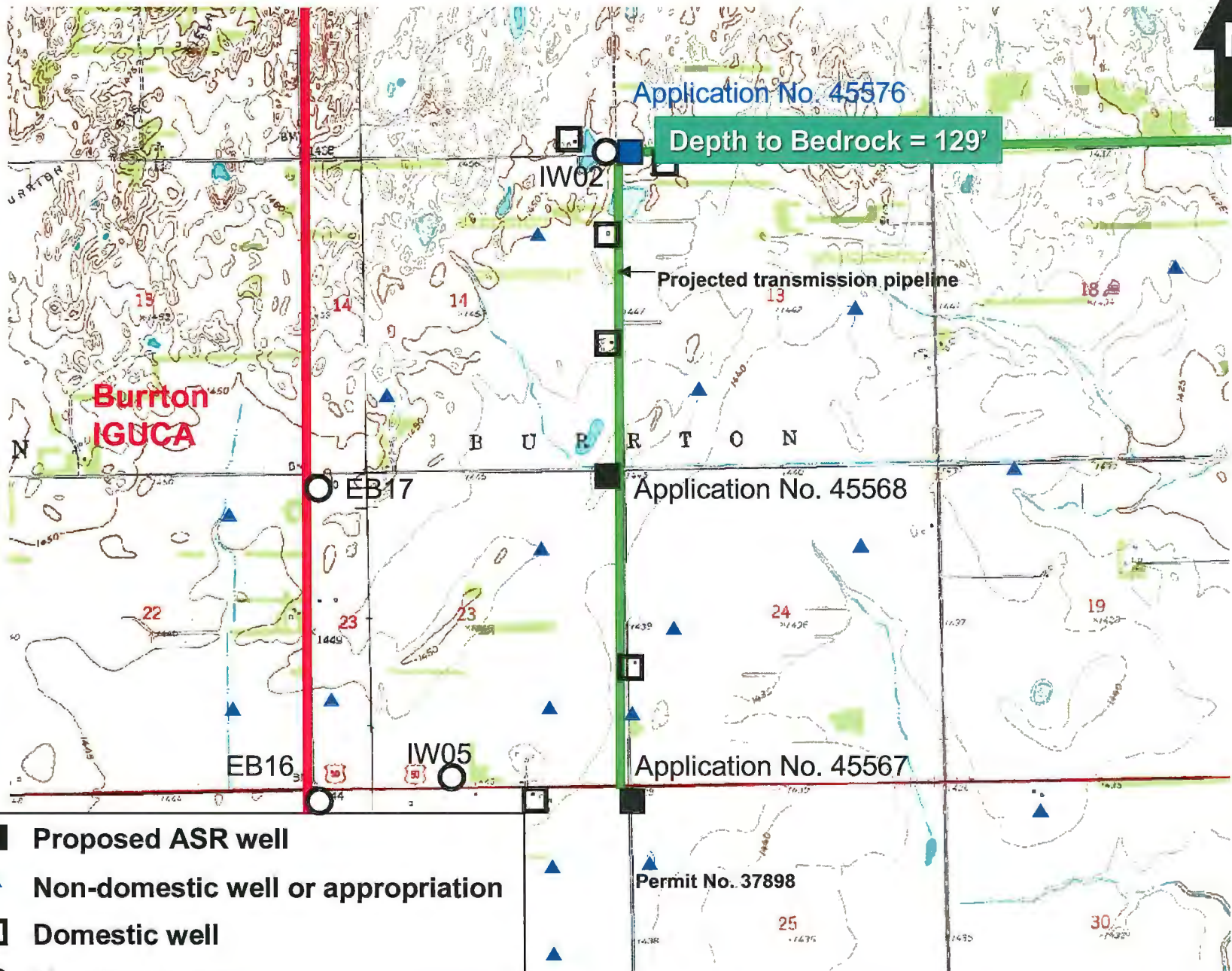
Direction from well? How many feet?

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	4	Topsoil	124	151	Clay, green
4	6	Clay, dark gray	151	154	Sand, coarse to fine
6	9	Clay, gray	154	190	Clay, dark gray with sand streaks
9	13	Clay, tan, sandy	190	205	Sand, coarse to fine with clay streaks
13	19	Gravel, coarse to fine with sand, coarse to fine	205	215	Clay, gray
19	62	Clay, tan and green with gravel streaks	215	219	Sand, coarse to fine
62	75	Sand, coarse to fine with clay streaks and gravel, medium, fine	219	232	Clay, green
			232	253	Sand, coarse to fine
75	90	Clay, dark gray with sand streaks, fine to medium	253	257	Clay, grayish brown
90	95	Sand, coarse to fine	257	265	Shale, black
95	102	Clay, tan and green with sand streaks			
102	106	Sand, coarse to fine			
106	119	Clay, green with sand streaks			
119	124	Sand, coarse to fine			

**7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION:** This water well was (1) constructed (2) reconstructed - or (3) plugged under my jurisdiction and was completed on (m/d/yr) 10-17-02 and this record is true to the best of my knowledge and belief, Kansas Water Well Contractor's License No. 185 This Water Well Record was completed on (m/d/yr) 10-24-02 under the business name of Clarke Well & Equipment, Inc. by (signature) *Clarke Well & Equipment, Inc.*

**INSTRUCTIONS:** Use typewriter or ball point pen. PLEASE PRESS ADJPLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send two copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66603-0001. Telephone 785-296-5324. Send one to WATERWELL OWNER and retain one for your records. Fee of \$5.00 for each completed well.

Figure 7. – Application No. 45568 Lithologic Log for Test Well at Proposed ASR Well Site



Application No. 45576

Depth to Bedrock = 129'

Projected transmission pipeline

Burrton  
IGUCA

BURRTON

Application No. 45568

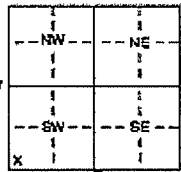
Application No. 45567

Permit No. 37898

- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well

**1] LOCATION OF WATER WELL:** Fraction Section Number Township Number Range Number  
 County: Harvey SW 1/4 SW 1/4 12 T 23 S R 3 E W  
 Distance and direction from nearest town or city street address of well if located within city?  
 Approximately 3 1/2 miles east and 2 miles north of Burdon

**2] WATER WELL OWNER:** City of Wichita Board of Agriculture, Division of Water Resources  
 RR#, St. Address, Box # : 455 N. Main Application Number:  
 City, State, ZIP Code : Wichita, KS 67202

**3] LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:** DEPTH OF COMPLETED WELL: 126 ft. ELEVATION: unknown  
  
 Depth(s) Groundwater Encountered 1 ft. 2 ft. 3 ft. ft.  
 WELL'S STATIC WATER LEVEL: not checked ft. below land surface measured on mo/day/yr  
 Pump test data: Well water was not checked ft. after hours pumping gpm  
 Est. Yield UNKNOWN gpm; Well water was ft. after hours pumping gpm  
 Bore Hole Diameter: 5 in. to 140 ft. and in. to ft.  
 WELL WATER TO BE USED AS:  
 1 Domestic 3 Foodst 6 Oil field water supply 9 Dewatering 12 Other (specify below)  
 2 Irrigation 4 Industrial 7 Domestic (lawn & garden) 10 Monitoring well  
 Was a chemical/bacteriological sample submitted to Department? Yes No  If yes, mo/day/yr sample was submitted  
 Water Well Disinfected? Yes No

**4] TYPE OF BLANK CASING USED:**  
 1 Steel 3 RMP (SR) 6 Wrought Iron 8 Concrete tile CASING JOINTS: Gland Clamped  
2 PVC 4 ABS 7 Fiberglass 9 Other (specify below) Welded  
 Threaded   
 Blank casing diameter 2 in. to 84 ft. Dia in. to ft. Dia in. to ft.  
 Casing height above land surface 24 in. weight 70 lbs./ft. Wall thickness or gauge No 154

**TYPE OF SCREEN OR PERFORATION MATERIAL:**  
 1 Steel 3 Stainless steel 5 Fiberglass 6 RMP (SR) 10 Asbestos-cement  
 2 Brass 4 Galvanized steel 6 Concrete tile 11 Other (specify)  
**SCREEN OR PERFORATION OPENINGS ARE:**  
 1 Continuous slot 3 Mesh slot 5 Gauzed wrapped 8 Wire wrapped 11 None (open hole)  
 2 Louvered shutter 4 Key punched 7 Torch-out 10 Other (specify) ft.  
**SCREEN PERFORATED INTERVALS:** From 84 ft. to 124 ft. From ft. to ft.  
 From ft. to ft. From ft. to ft.  
**GRAVEL PACK INTERVALS:** From 55 ft. to 140 ft. From ft. to ft.  
 From ft. to ft. From ft. to ft.

**5] GROUT MATERIAL:** 1 Neat cement 2 Cement grout 3 Bentonite 4 Other Bentonite Hole Plug  
 Grout intervals: From ft. to ft. From ft. to ft. From 0 ft. to 55 ft.  
 What is the nearest source of possible contamination:  
 1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well  
 2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well  
 3 Water-tight former lines 6 Septage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)  
 None known  
 Direction from well? How many feet?

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	3	Topsoil	103	109	Clay, green, hard
3	13	Clay, brown, sandy, soft	109	124	Sand, coarse to very fine with gravel, fine
13	17	Clay, reddish brown, sandy, soft	124	129	Clay, dark gray
17	27	Sand, coarse to very fine, loose	129	140	Shale, black, hard
27	53	Clay, tan, hard			
53	62	Sand, coarse to very fine, loose			
62	64	Clay, green, hard			
64	76	Sand, coarse to very fine, loose, clean			
76	77	Clay, green, hard			
77	82	Sand, coarse to very fine with gravel, fine, loose, clean			
82	91	Clay, green, hard, sand streak at 89'			
91	103	Sand, coarse to very fine with gravel, fine, loose, clean			

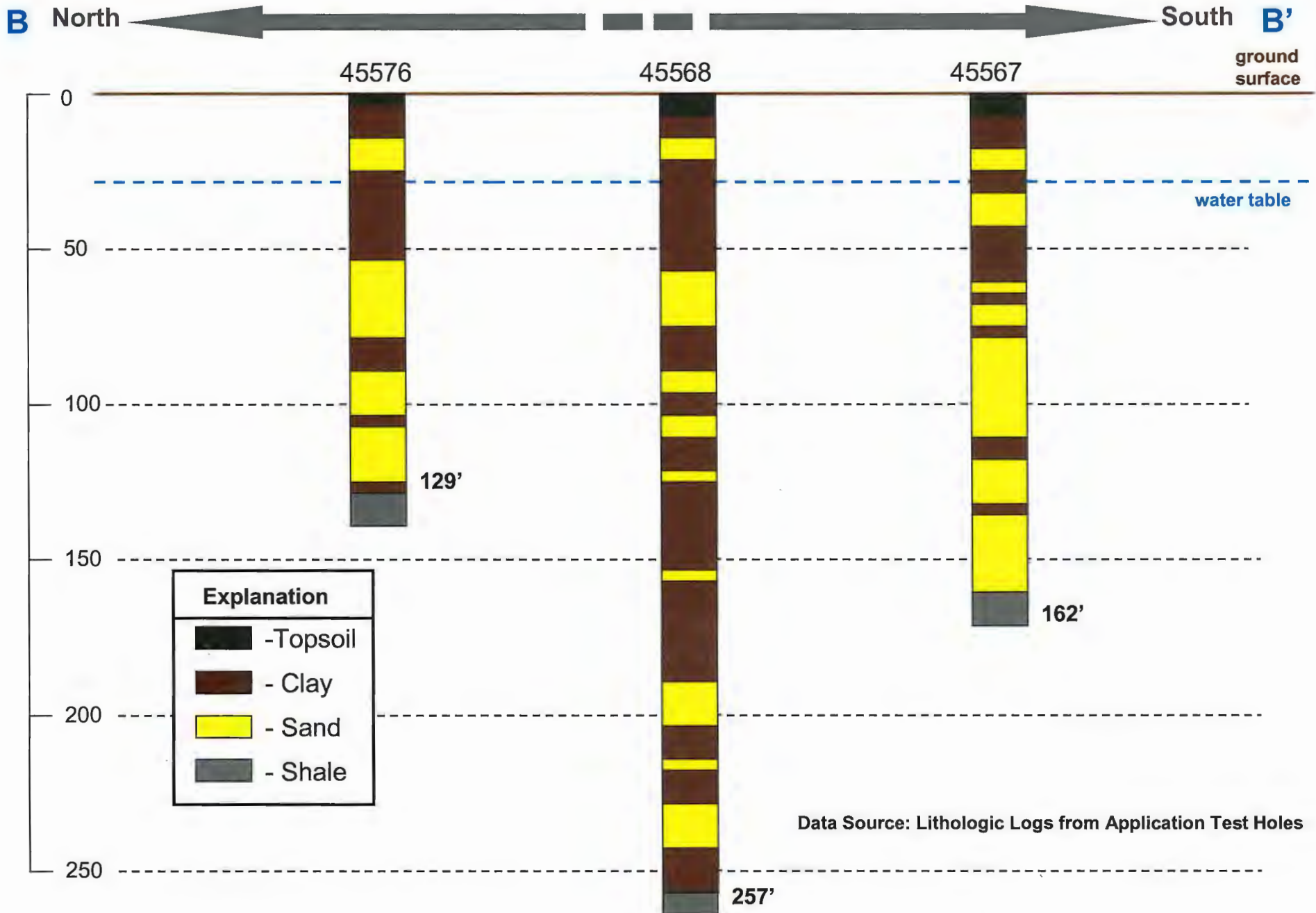
**6] CONTRACTORS OR LANDOWNERS CERTIFICATION:** This water well was (1) constructed (2) reconstructed or (3) plugged under my jurisdiction and was completed on (mo/day/yr) 12-19-02 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No 185 This Water Well Record was completed on (mo/day/yr) 12-31-02 under the business name of Clarke Well & Equipment, Inc. by (signature) *[Signature]*

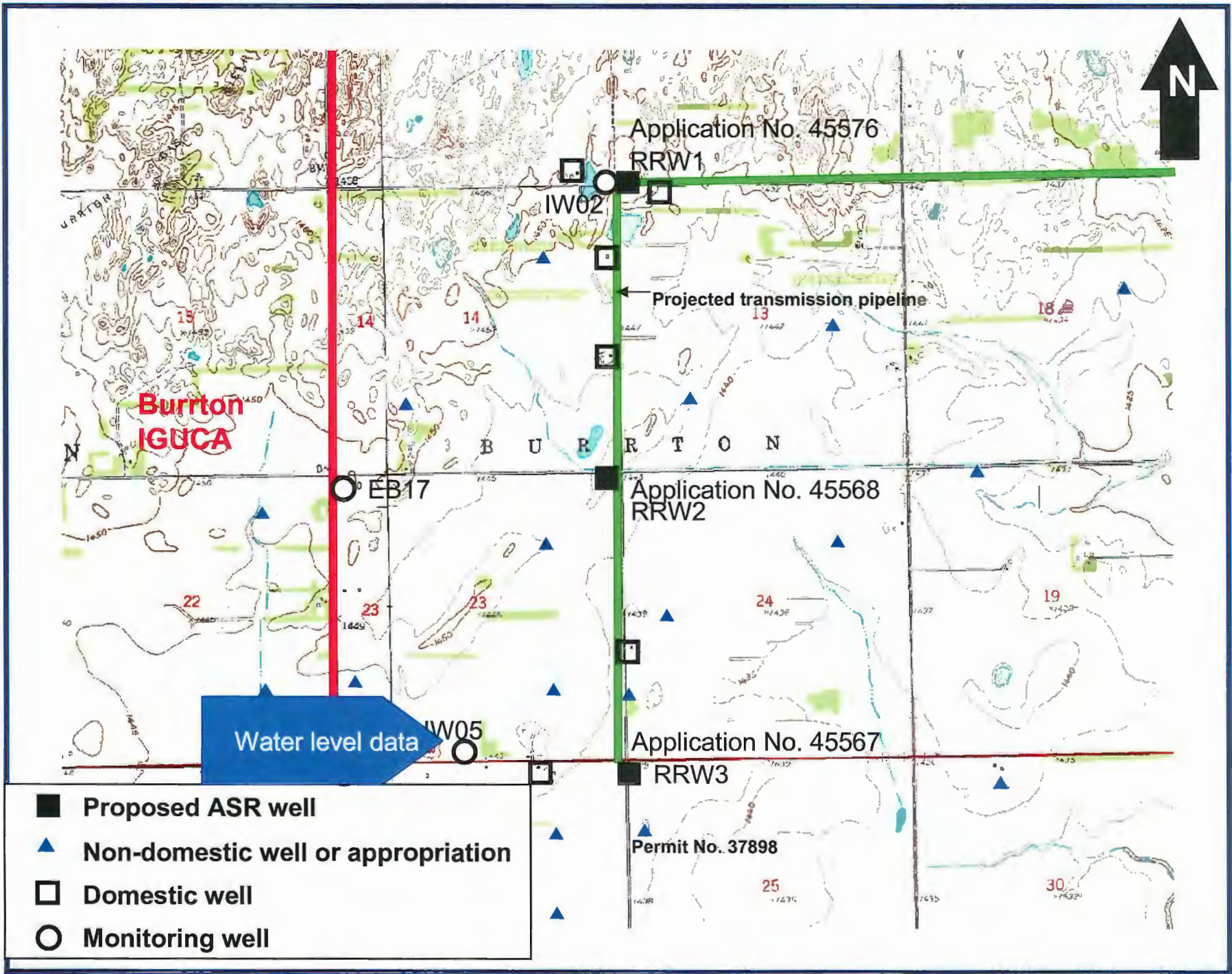
**INSTRUCTIONS:** Use typewriter or ball point pen. PLEASE PRESS **HEAVILY** and **PRINT** clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66629-0001. Telephone 785-296-5924. Send one to WATER WELL OWNER and retain one for your records. Fee of \$5.00 for each constructed well.

Figure 7. – Application No. 45576 Lithologic Log for Test Well at Proposed ASR Well Site



# Generalized Lithology of Equus Beds Aquifer at Bank Storage Withdrawal Site, Sec. 8, T23S, R2W





Application No. 45576  
RRW1

IW02

Projected transmission pipeline

**Burrton  
IGUCA**

B U R R T O N

EB17

Application No. 45568  
RRW2

Water level data

IW05

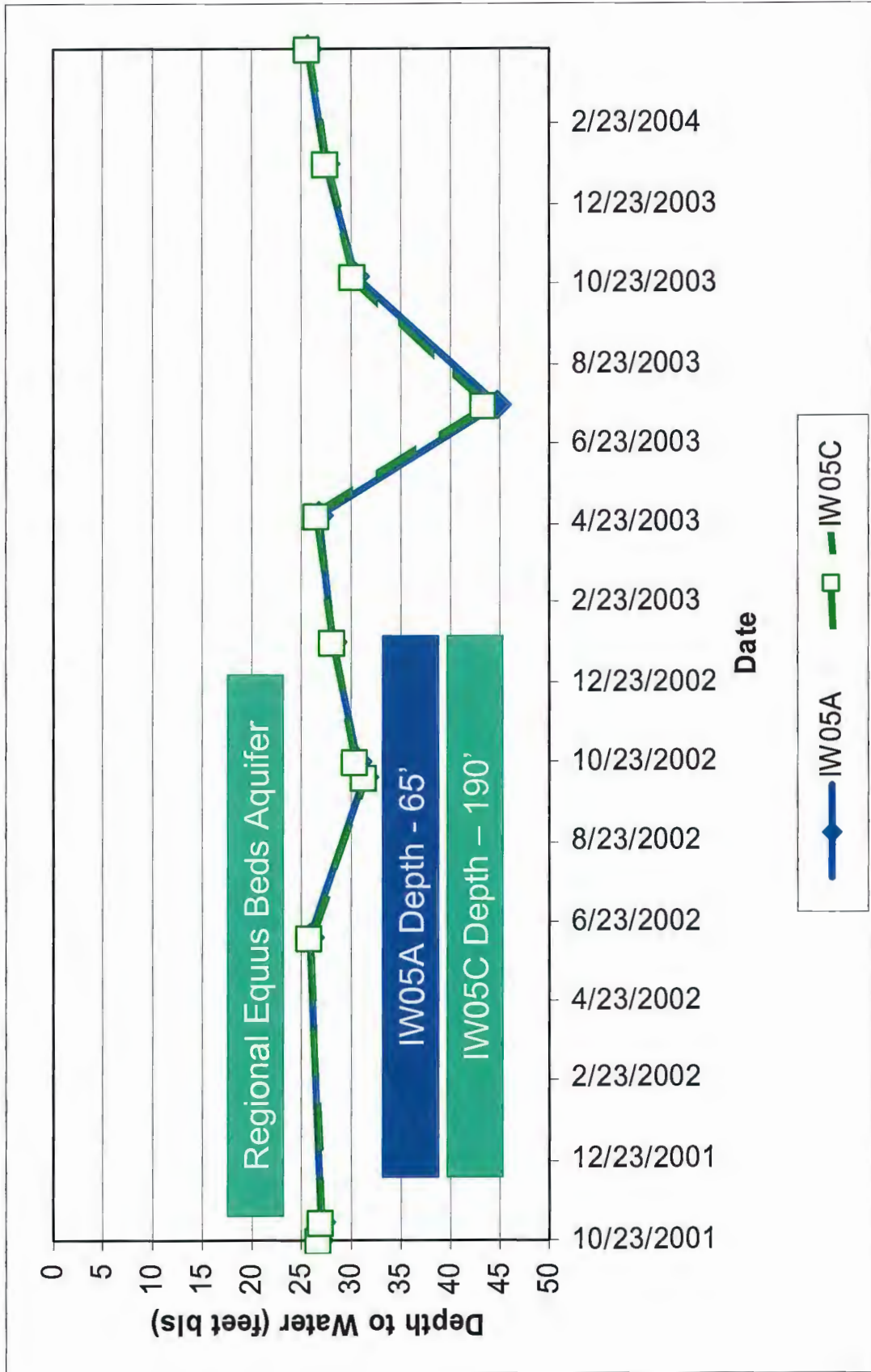
Application No. 45567  
RRW3

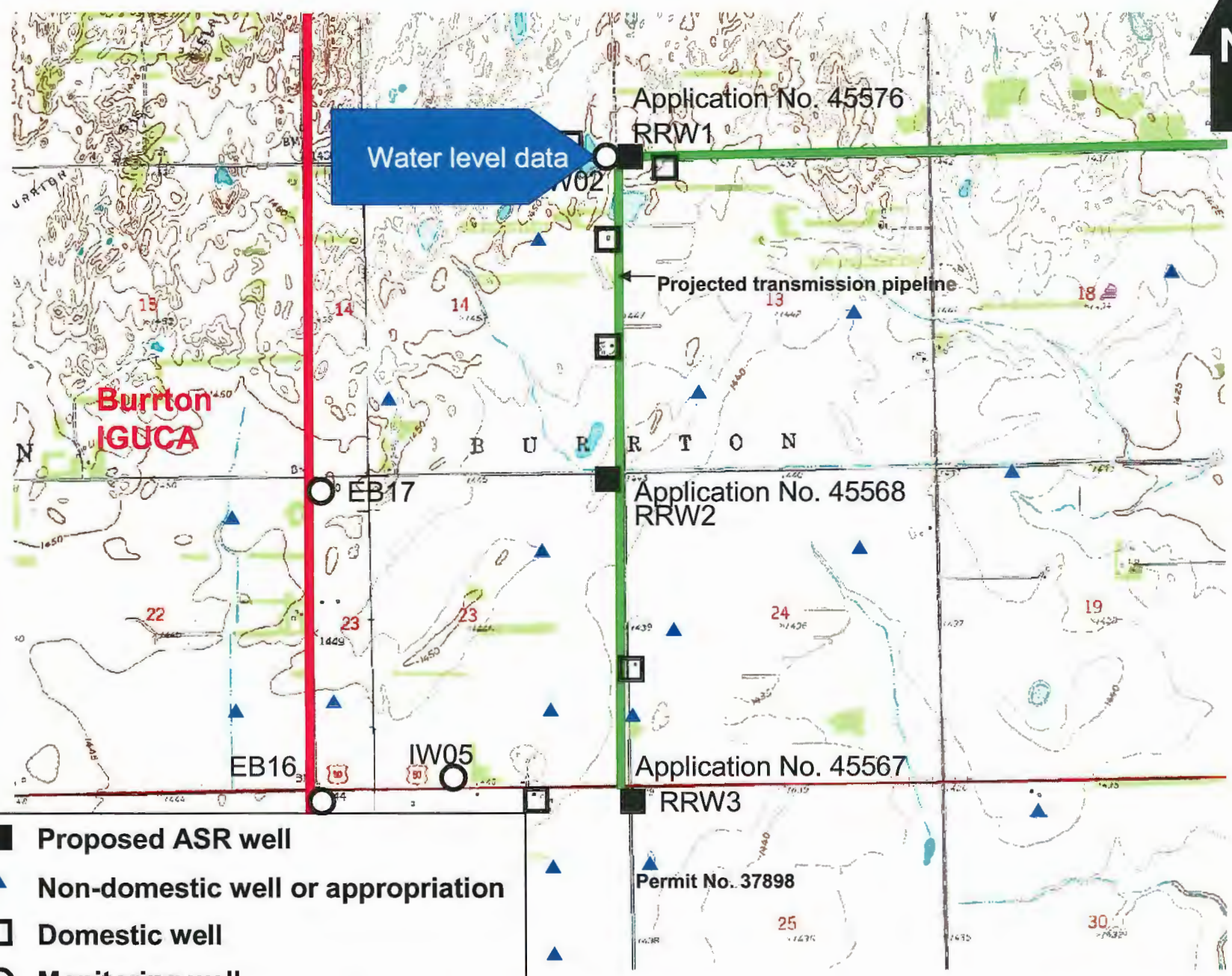
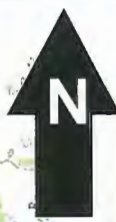
Permit No. 37898

- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well



Groundwater Monitoring Site IW05  
SE-SW-SE Sec. 23, T23S, R3W





Water level data

Application No. 45576  
RRW1

Projected transmission pipeline

**Burrton  
IGUCA**

B U R R T O N

Application No. 45568  
RRW2

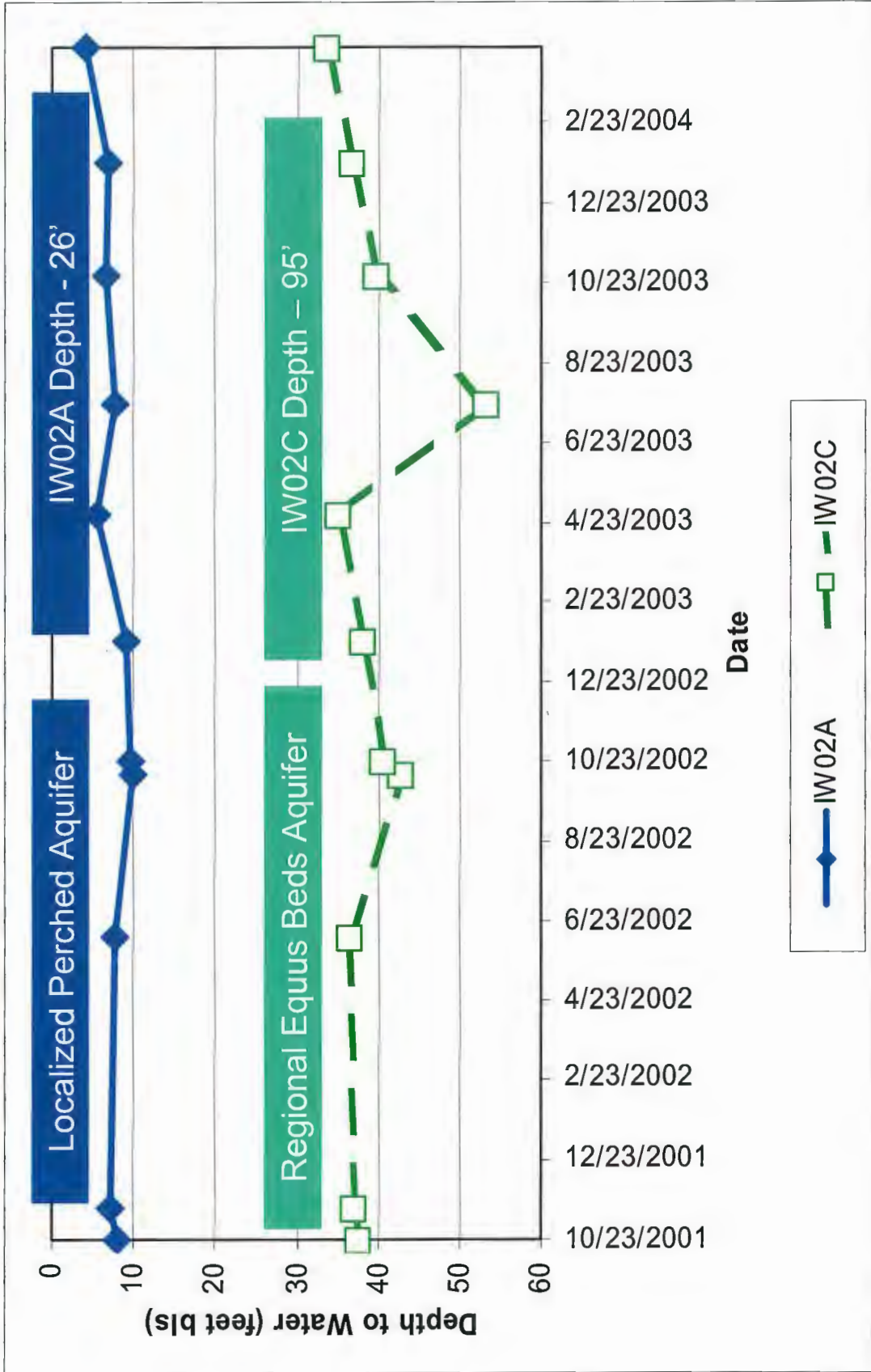
Application No. 45567  
RRW3

Permit No. 37898

- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well



Groundwater Monitoring Site IW02  
 SW-SW-SW Sec. 12, T23S, R3W



IW02A Depth – 26 feet  
 IW02C Depth – 95 feet

**Aquifer Storage and Recovery  
Well Applications  
45567, 45568 and 45576**

**Basin Storage Area**

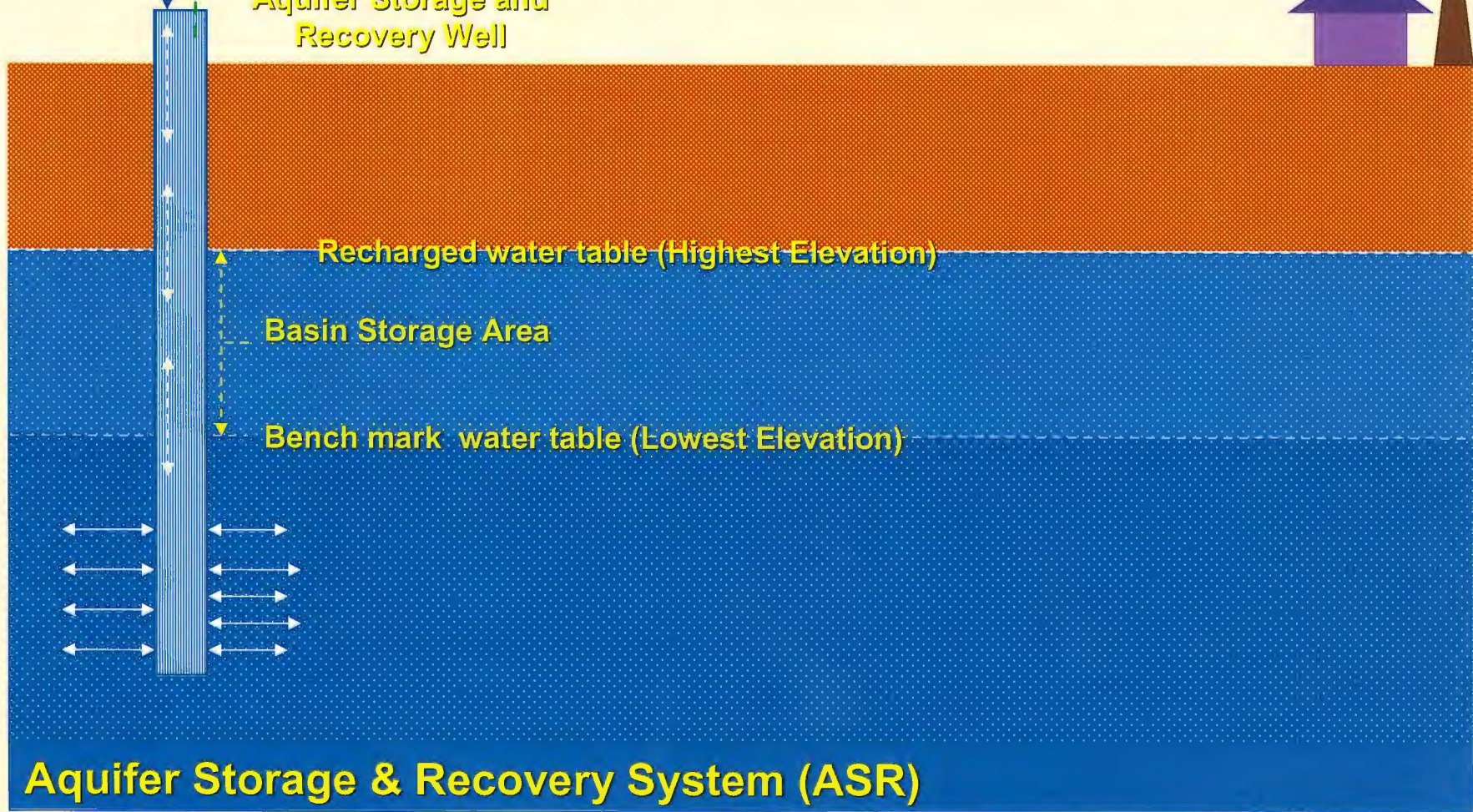


From Bank storage well



Recharge Credits to City, less storage loss

Aquifer Storage and Recovery Well



**Aquifer Storage & Recovery System (ASR)**

**Aquifer Storage and Recovery  
Well Applications  
45567, 45568 and 45576**

**Staff Recommendations**



## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 1. the ASR well site proposed by application no. 45567 is moved to a location that complies with Well Spacing Regulation K.A.R. 5-22-2;**
- 2. the basin storage area shall be defined in compliance with K.A.R. 5-5-1(k) specifying the portion of the aquifer's unsaturated zone used for aquifer storage that has defined horizontal boundaries and is delimited by the highest and lowest index water level elevations;**
- 3. monitoring of the basing storage area shall include water levels, water quality, water use, water storage, water recovery, precipitation, basic data access and operational reports;**



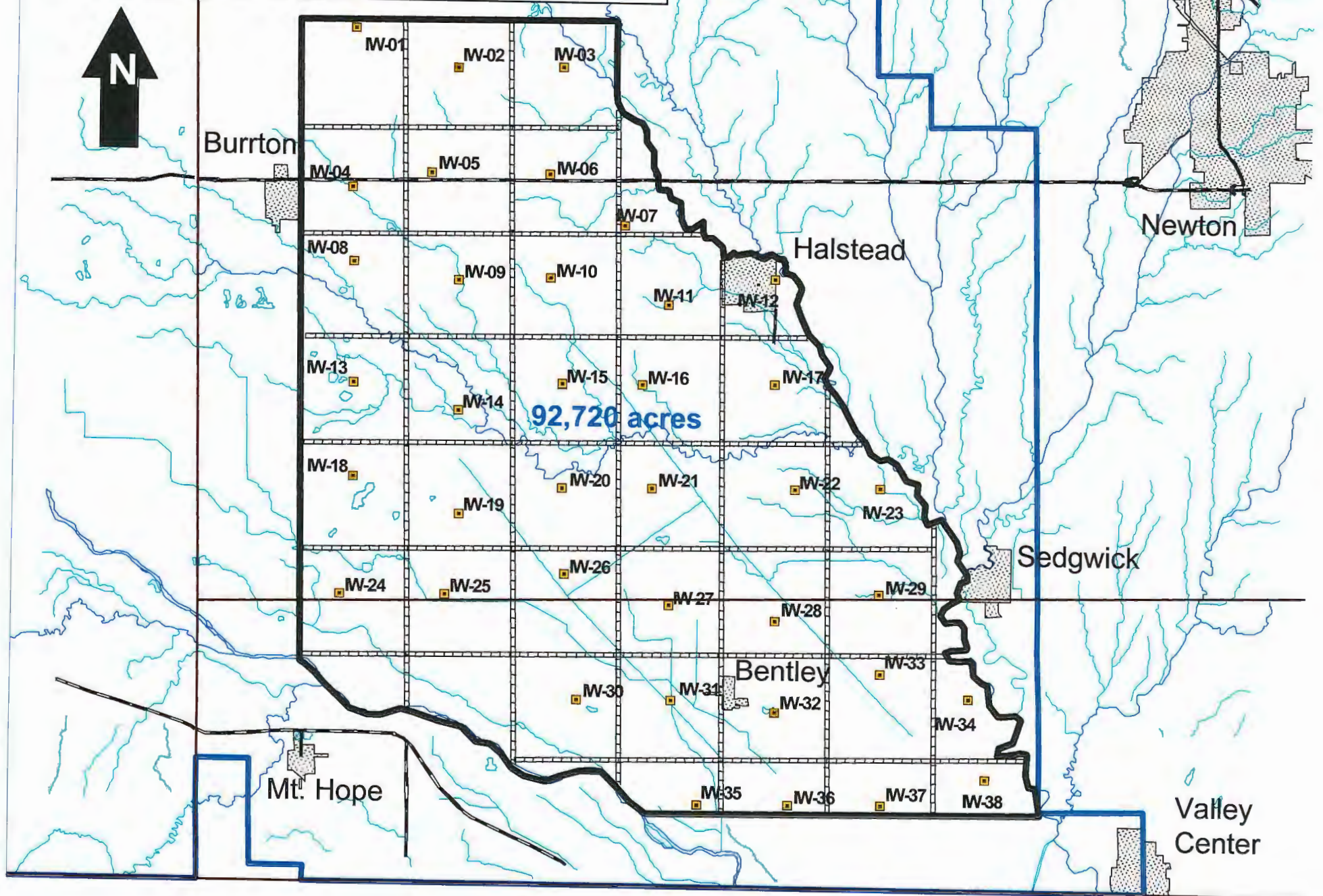
## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 4. a monitoring well network is established using Kansas Geological Survey methodology to determine index water levels in each water budget accounting unit, and monitoring water levels for water balance calculations and determination of recharge credits;**
- 5. as determined by Kansas Geological Survey methodology the basin storage area is divided into 38 water budget accounting units and each unit is assigned an index identification number;**



**Figure 3. – Basin Storage Area Map**  
Prepared by: Equus Beds Groundwater Management District No. 2





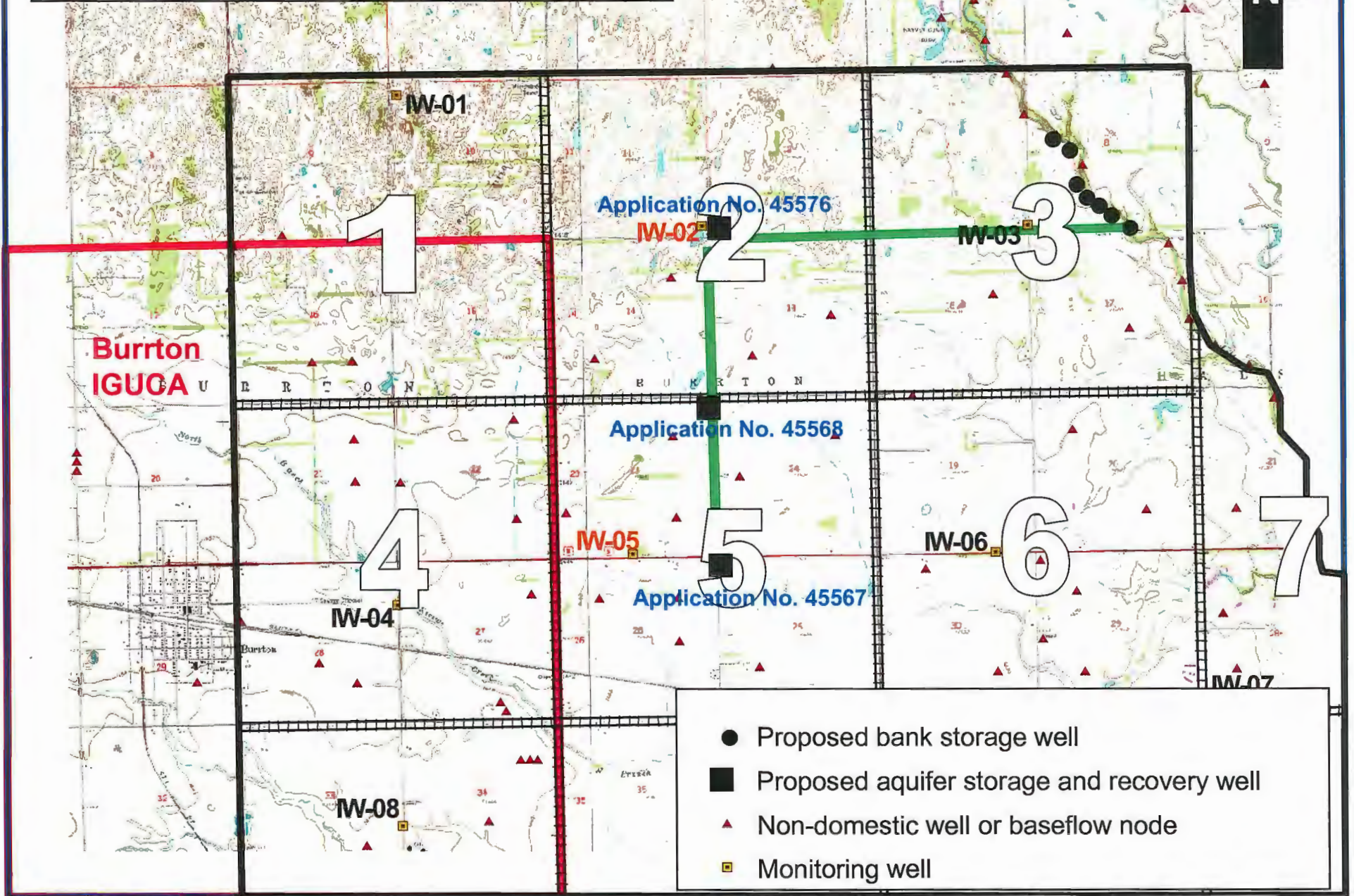
## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 6. the index water levels are established in compliance with K.A.R. 5-5-1(00), to designate water level elevations spatially throughout the basin storage area, to be used to represent the maximum volume of a basin storage area, and storage available for recovery based upon accounting methodology, and conditions of the permit;**
- 7. the highest index water level shall be limited to the predevelopment water table measurement or computed gradient based on KGS Bulletin 79 data or a minimum depth of 10 feet below land surface at the point of lowest land surface elevation in water budget accounting unit index no. 2 and no. 5;**



**Figure 5. – Basin Storage Area Accounting Unit Map**  
Prepared by: Equus Beds Groundwater Management District No. 2



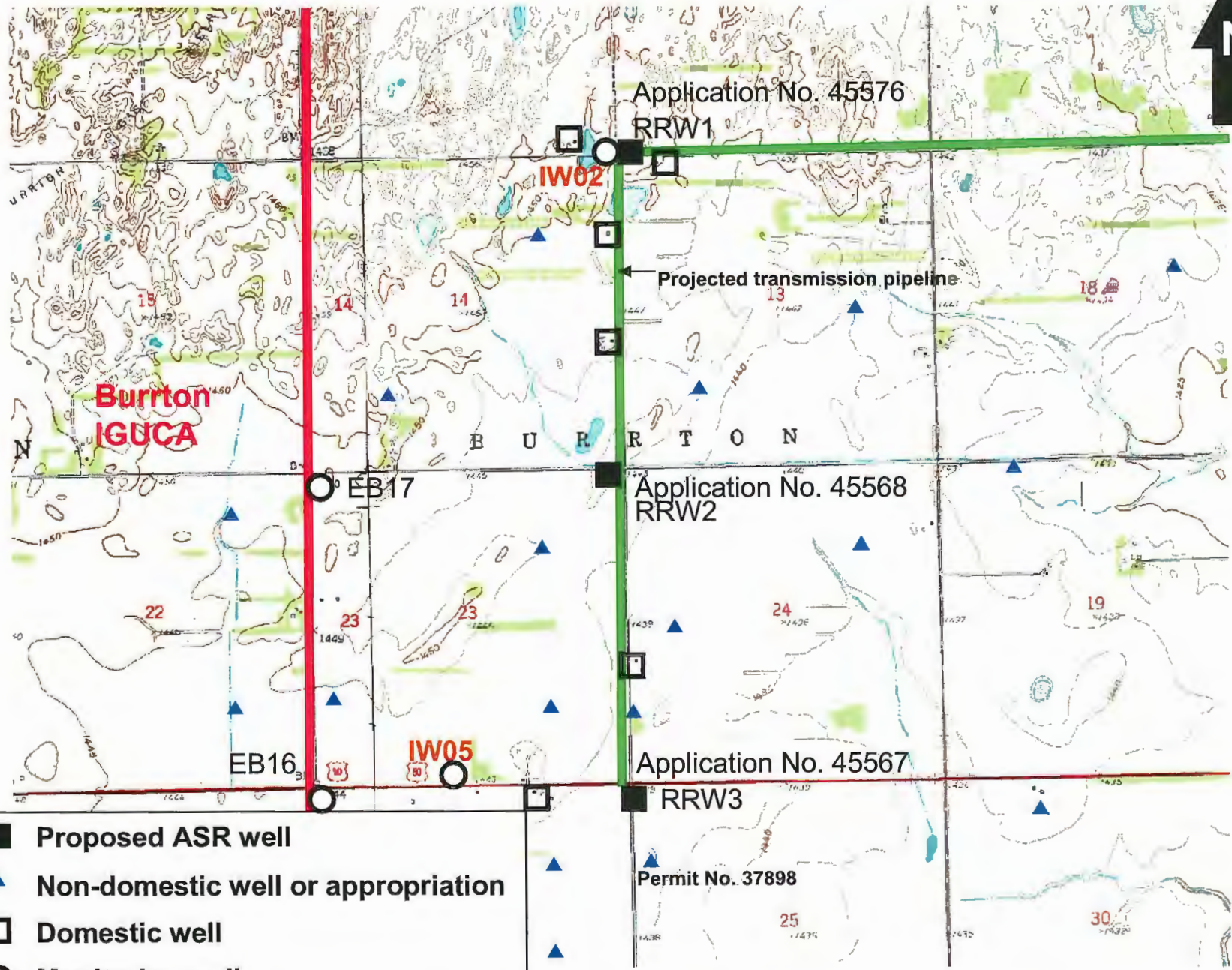


## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 7. the lowest index water level for application no. 45576 shall be based on index well no. 2 January 2003 measurement of 1411.34 feet msl (38.16 feet bls) and the highest index water level shall be 1427.5 feet msl (22 feet bls), based on the predevelopment water level for accounting unit index no. 2, as determined from Kansas Geological Survey Bulletin 79 (1949);**
- 8. the lowest index water level for applications no. 45567 and 45568 shall be based on index well no. 5 January 2003 measurement of 1414.47 feet msl (28.13 feet bls) and the highest index water level shall be 1425 feet msl (17.6 feet bls), based on the predevelopment water level for accounting unit index no. 2, as determined from Kansas Geological Survey Bulletin 79 (1949);**





- Proposed ASR well
- ▲ Non-domestic well or appropriation
- Domestic well
- Monitoring well

Application No. 45576  
RRW1

Application No. 45568  
RRW2

Application No. 45567  
RRW3

Permit No. 37898

**Burrton  
IGUCA**

IW02

IW05

EB17

EB16

Projected transmission pipeline

BURRTON

BURRTON



## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 9. water level monitoring data from index well no. 2 and no. 5 shall be used in calculations of water balance and determination of recharge credits for the proposed ASR applications;**
- 10. the total volume of the basin storage area shall be calculated in acre-feet utilizing the established highest and lowest index well levels for each water budget accounting unit, the area of the basin storage area, and the storage coefficient of the aquifer in each accounting unit;**
- 11. the water balance to determine change in the basin storage area shall be calculated, where total inflow minus total outflow equals the change in groundwater storage;**



From Bank storage well



Recharge Credits to City, less storage loss

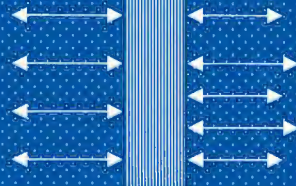
Aquifer Storage and Recovery Well



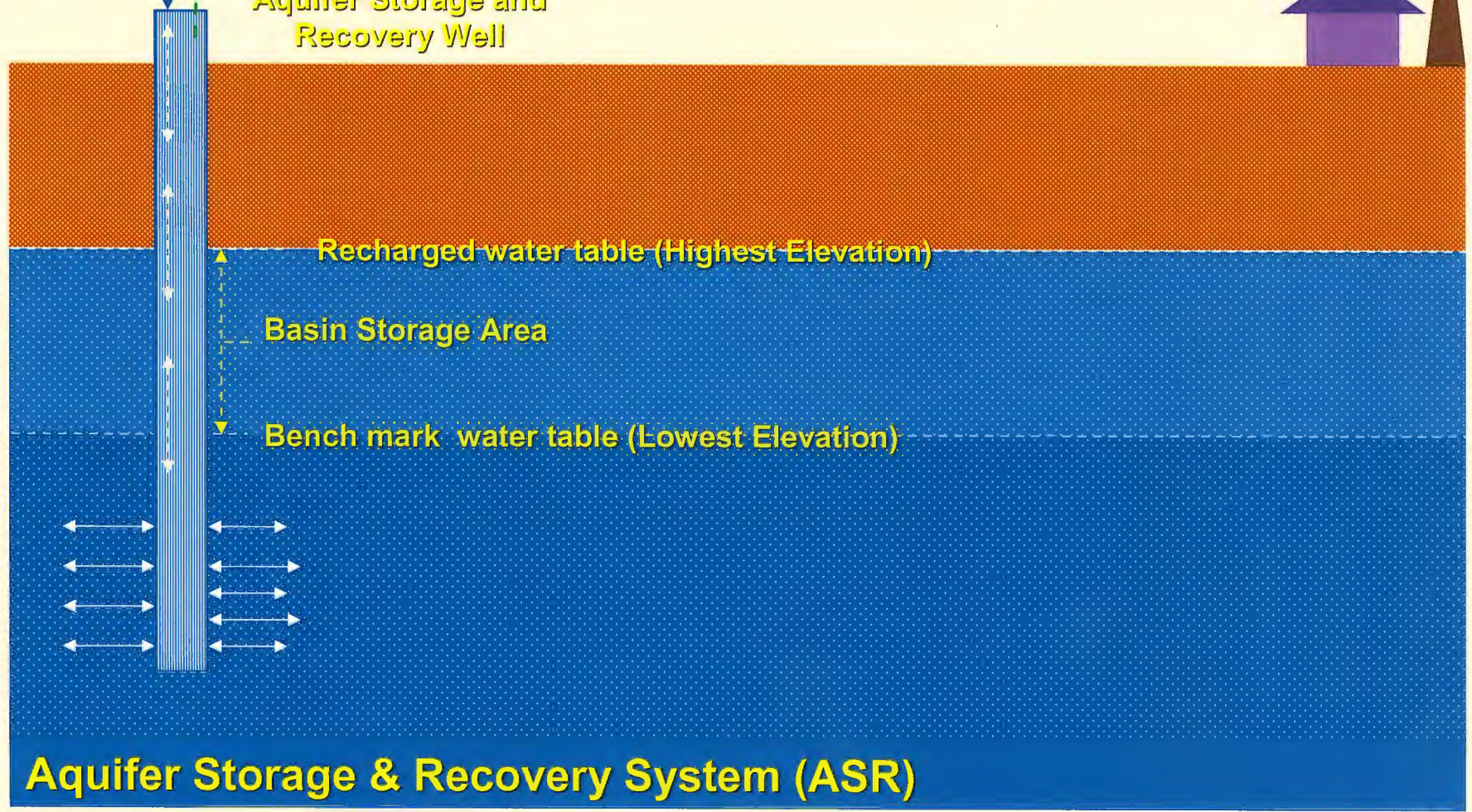
Recharged water table (Highest Elevation)

Basin Storage Area

Bench mark water table (Lowest Elevation)



**Aquifer Storage & Recovery System (ASR)**





## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 12. the inflow data utilized in water balance calculations shall include natural recharge, groundwater and stream inflow, artificial recharge, and any other source of water deemed inflow by the District or the Division of Water Resources;**
- 13. the outflow data utilized in water balance calculations shall include evapotranspiration, baseflow, groundwater and stream outflow, non-domestic well use, and any other source of water deemed outflow by the District or the Division of Water Resources;**
- 14. the proposed recovery of water artificially recharged by the operator of the aquifer storage and recovery system shall only occur when recharge credits are determined to be available;**



# Water Balance

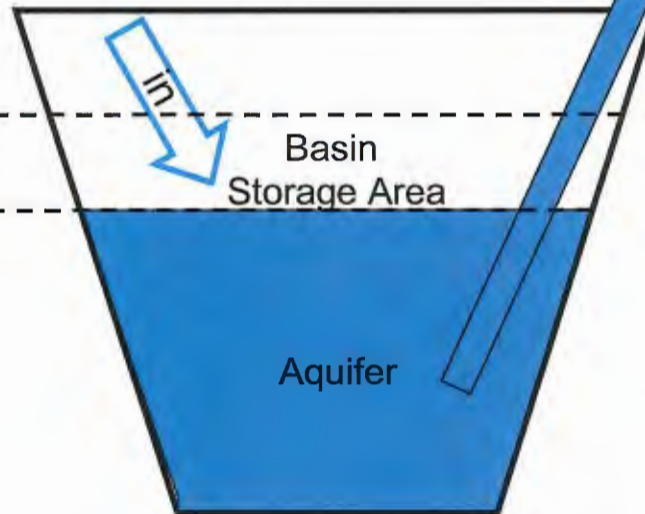
## Total Inflow

- Natural recharge
- Groundwater inflow
- Stream inflow
- Artificial recharge



High Index Water Level

Low Index Water Level

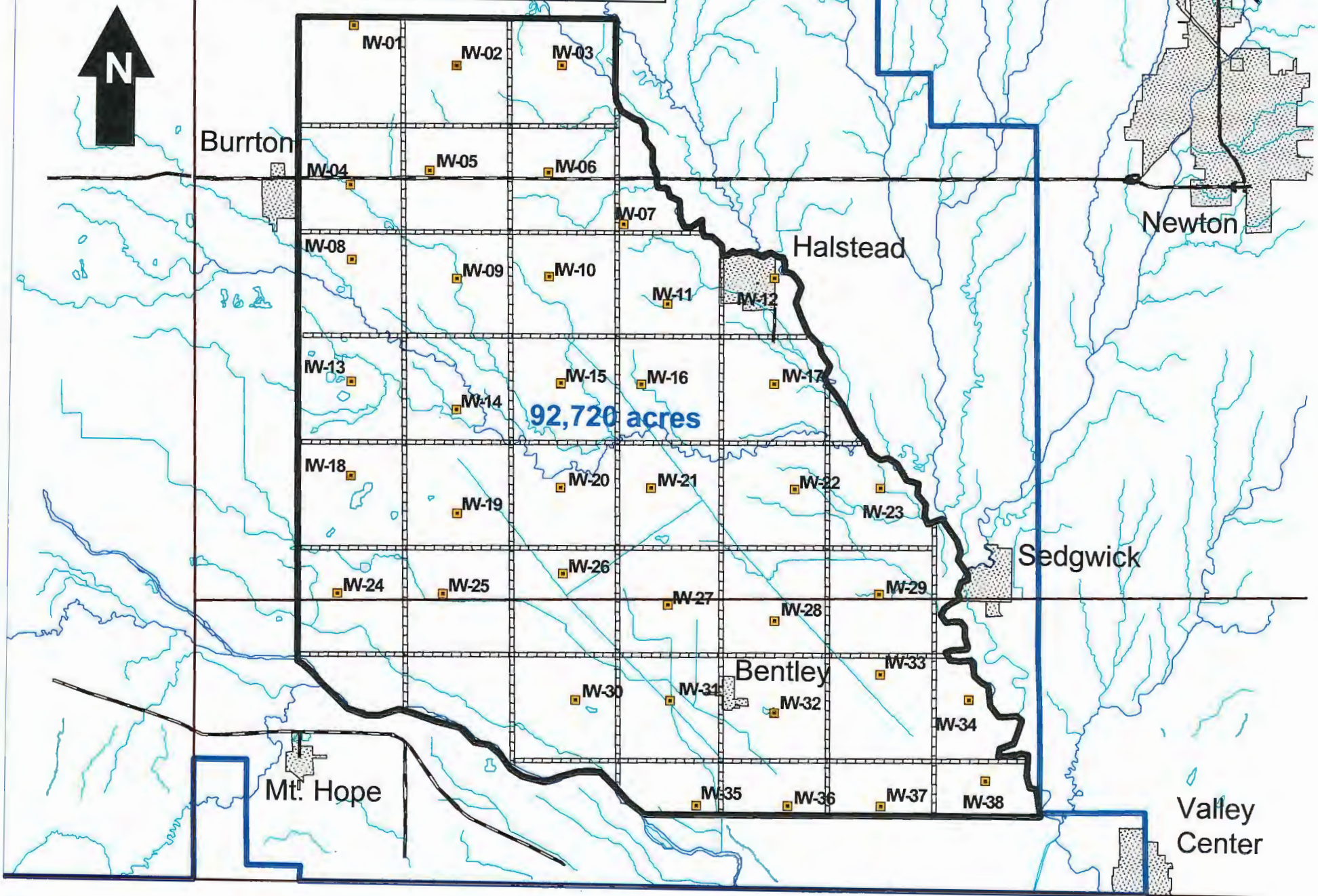


## Total Outflow

- Evapotranspiration
- Baseflow
- Groundwater outflow
- Stream outflow
- Well withdrawal

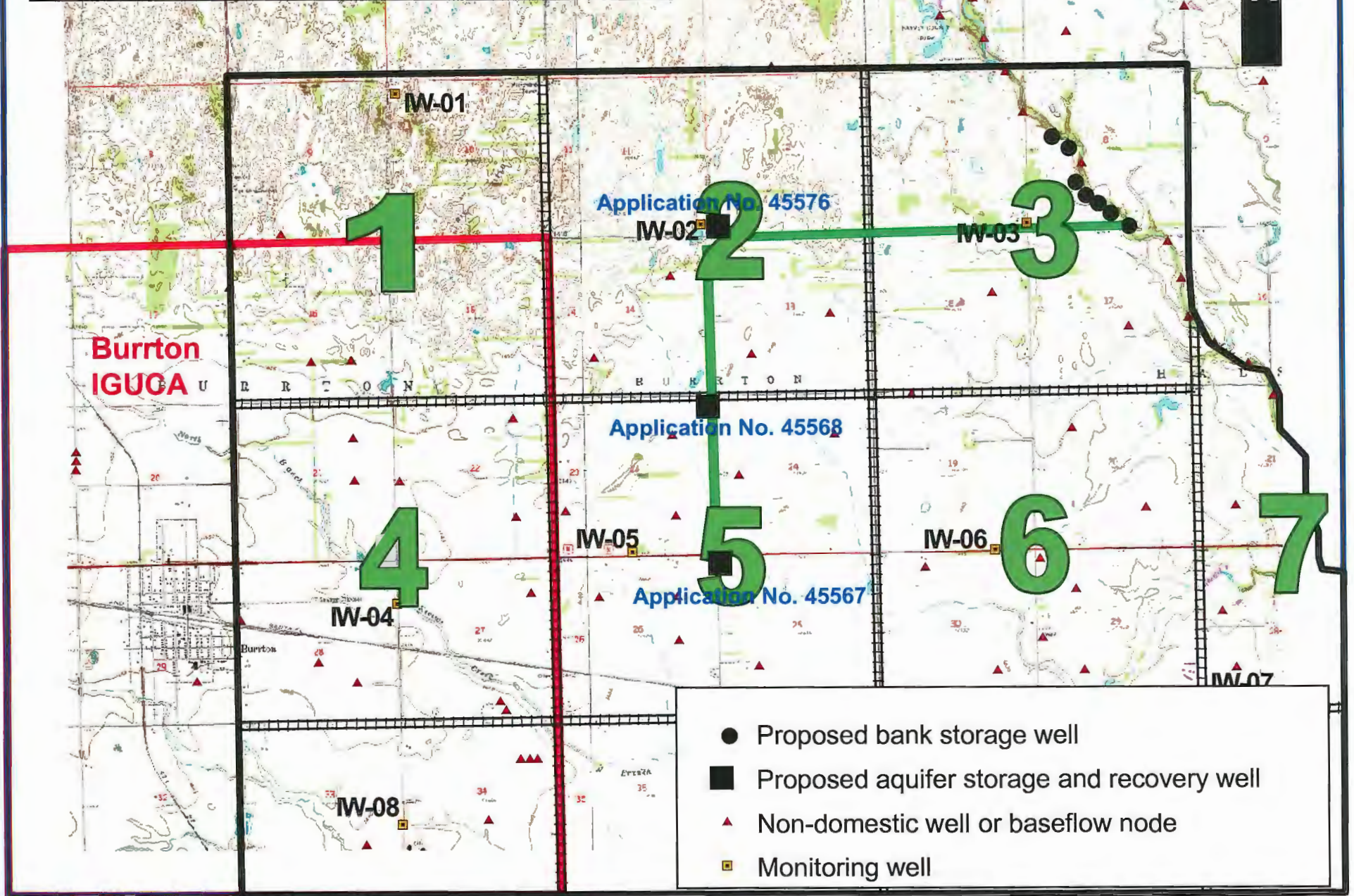


**Figure 3. – Basin Storage Area Map**  
Prepared by: Equus Beds Groundwater Management District No. 2





**Figure 5. – Basin Storage Area Accounting Unit Map**  
Prepared by: Equus Beds Groundwater Management District No. 2



- Proposed bank storage well
- Proposed aquifer storage and recovery well
- ▲ Non-domestic well or baseflow node
- Monitoring well



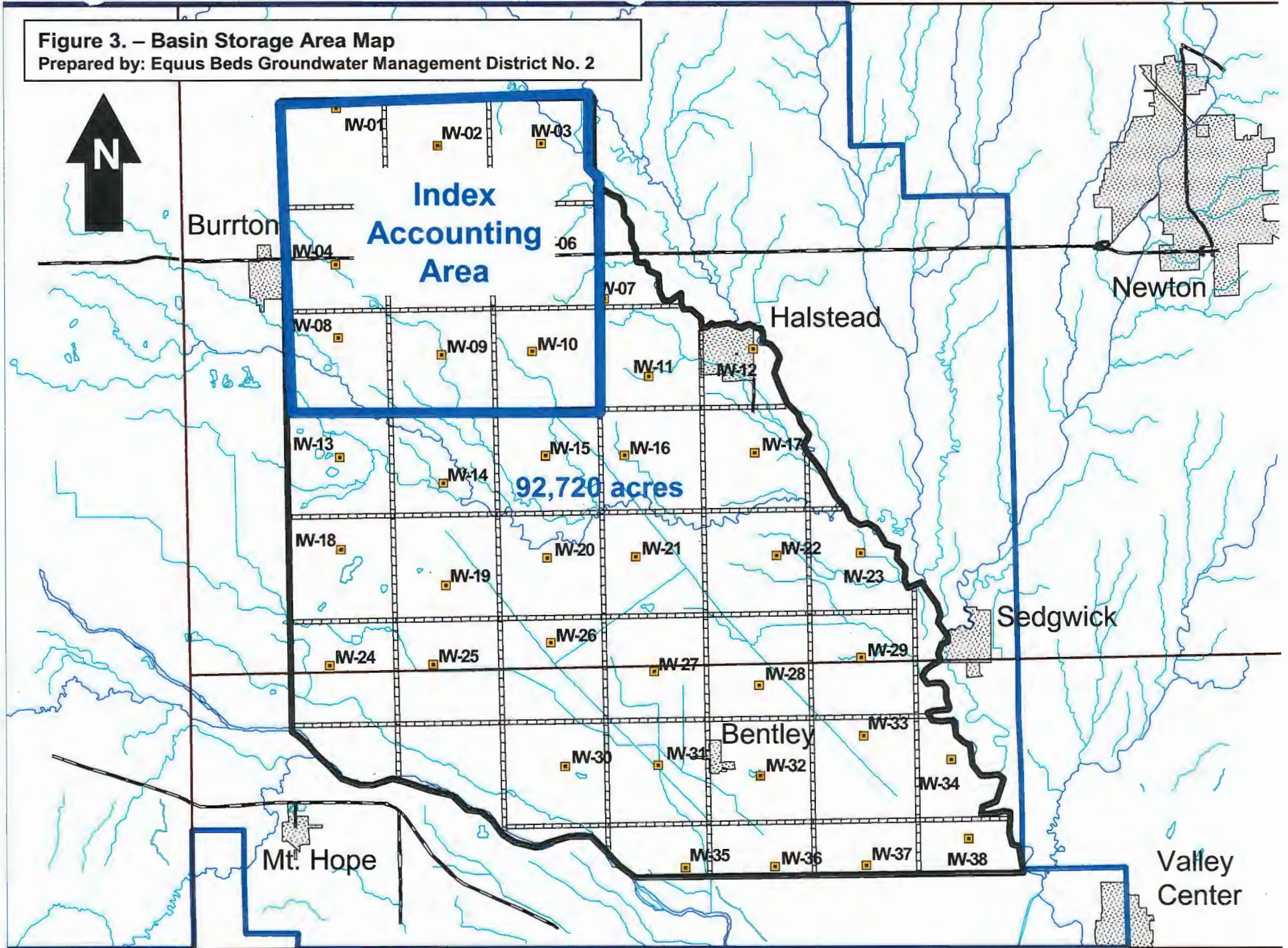
## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

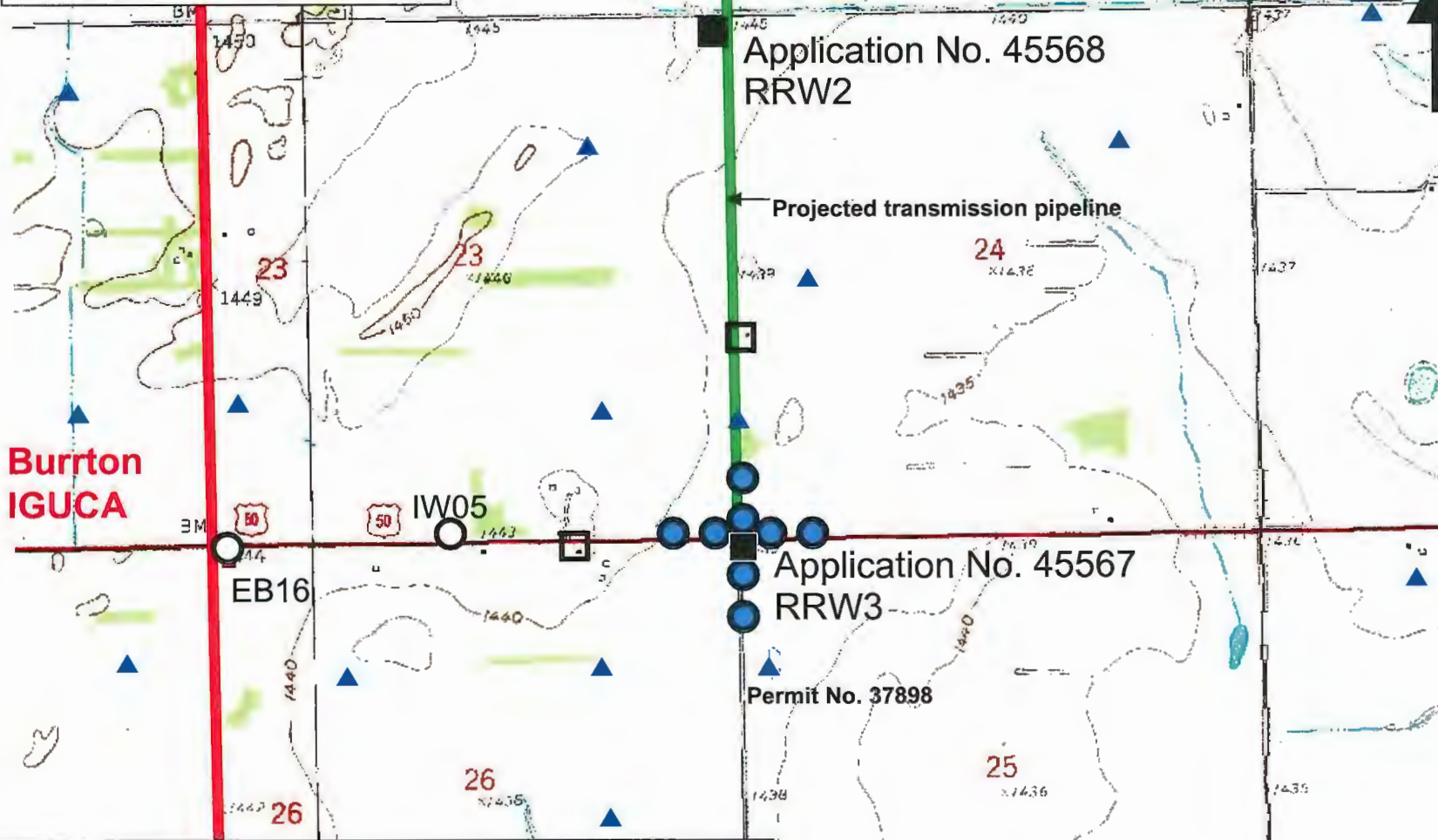
- 15. determination of recharge credits for the proposed ASR applications shall be computed through water balance methodology utilizing index data from water budget accounting unit nos. 1, 2, 3, 4, 5, 6, 8, 9 and 10;**
- 16. a monitoring well network is installed at the applicant's expense to monitor the aquifer storage and recovery sites as shown on Attachments 45567-A, 45568-A and 45576-A, and shall include existing monitoring well sites IW02 and IW05;**



**Figure 3. – Basin Storage Area Map**  
Prepared by: Equus Beds Groundwater Management District No. 2



**Attachment 45567-A.**



**Burton  
IGUCA**

**Application No. 45568  
RRW2**

**Projected transmission pipeline**

**Application No. 45567  
RRW3**

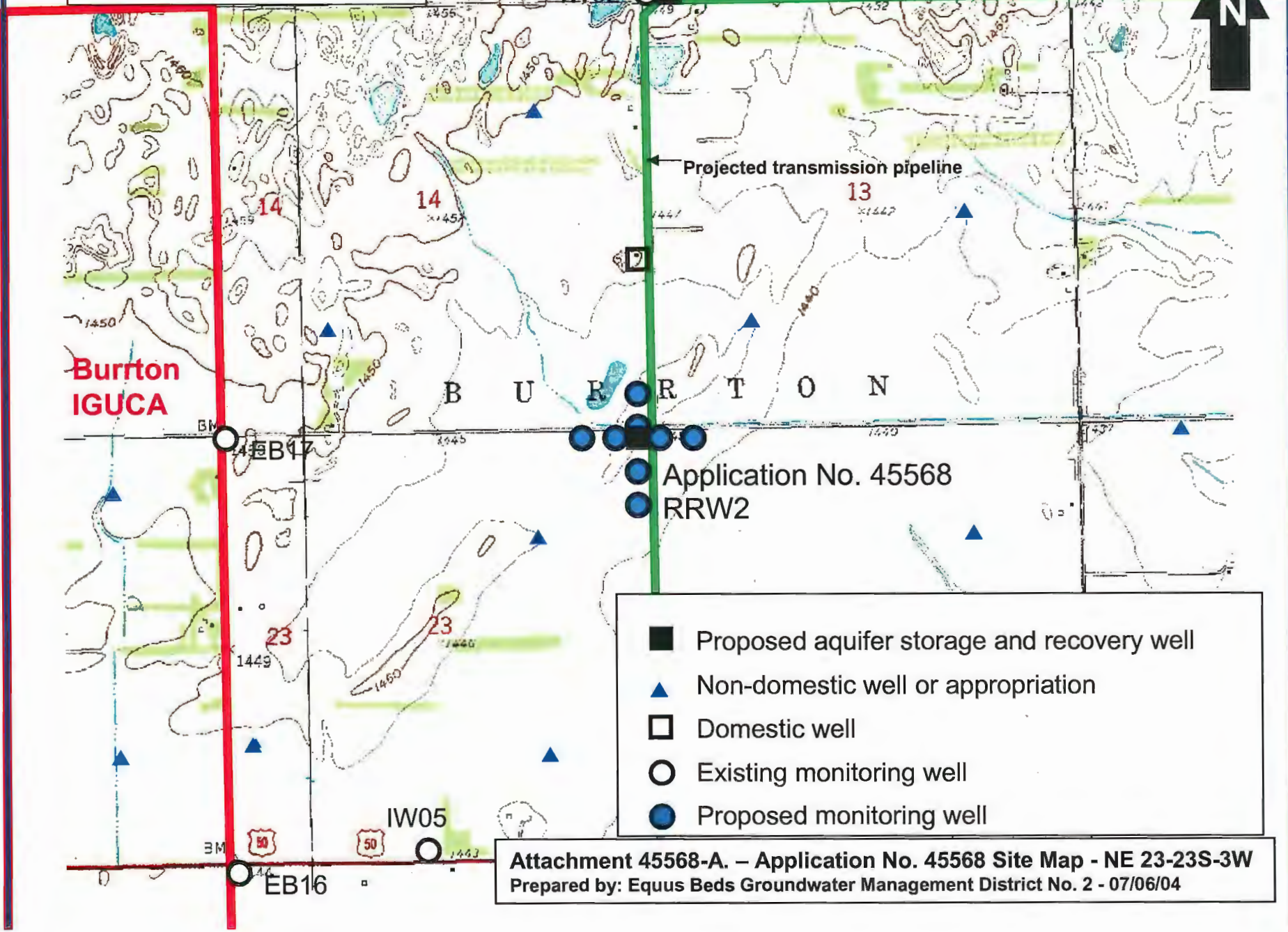
**Permit No. 37898**

- Proposed aquifer storage and recovery well
- ▲ Non-domestic well or appropriation
- Domestic well
- Existing monitoring well
- Proposed monitoring well

**Attachment 45567-A. – Application No. 45567 Site Map - NW 25-23S-3W**  
Prepared by: Equus Beds Groundwater Management District No. 2 - 07/06/04

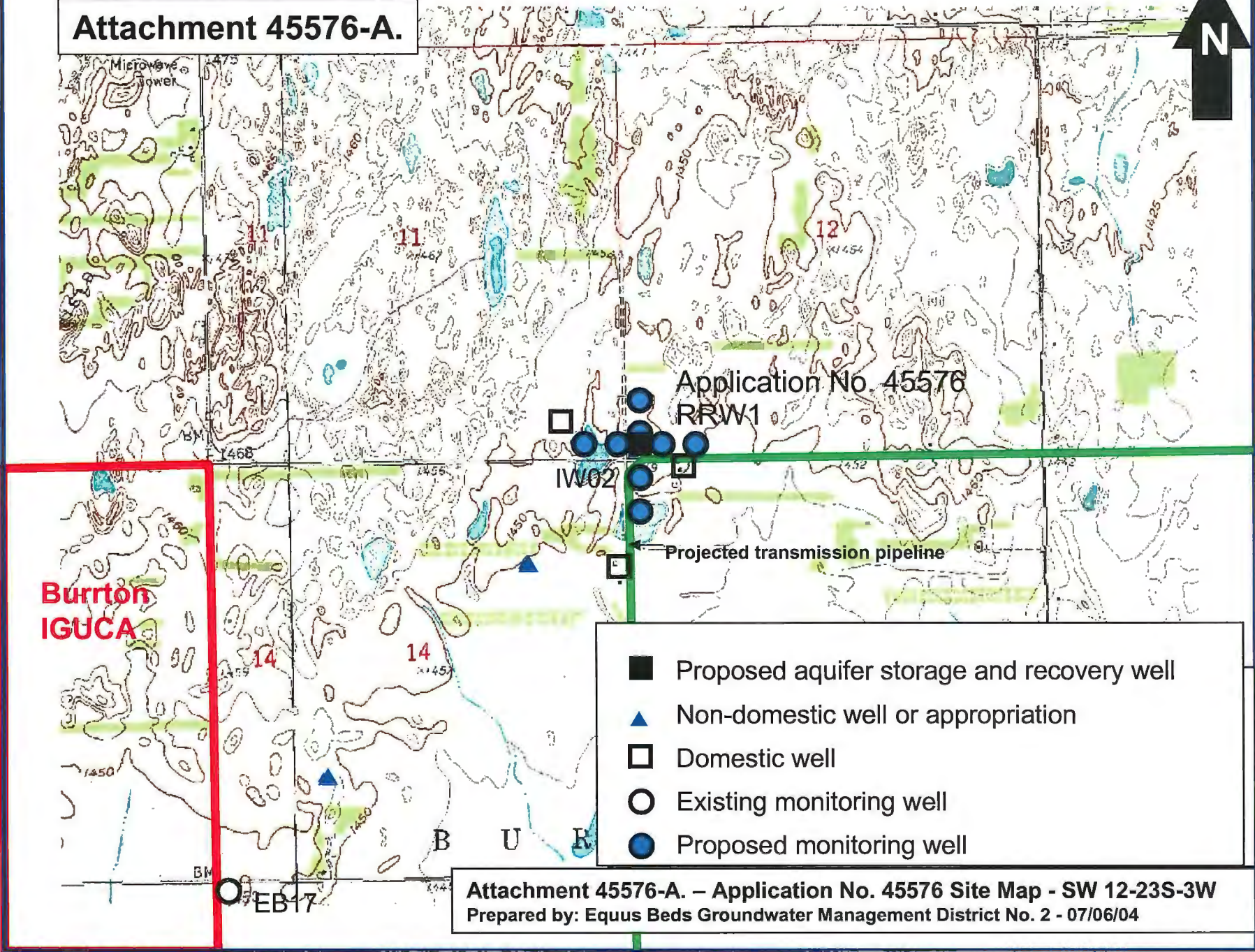


# Attachment 45568-A.





# Attachment 45576-A.



Application No. 45576  
RRW1

IW02

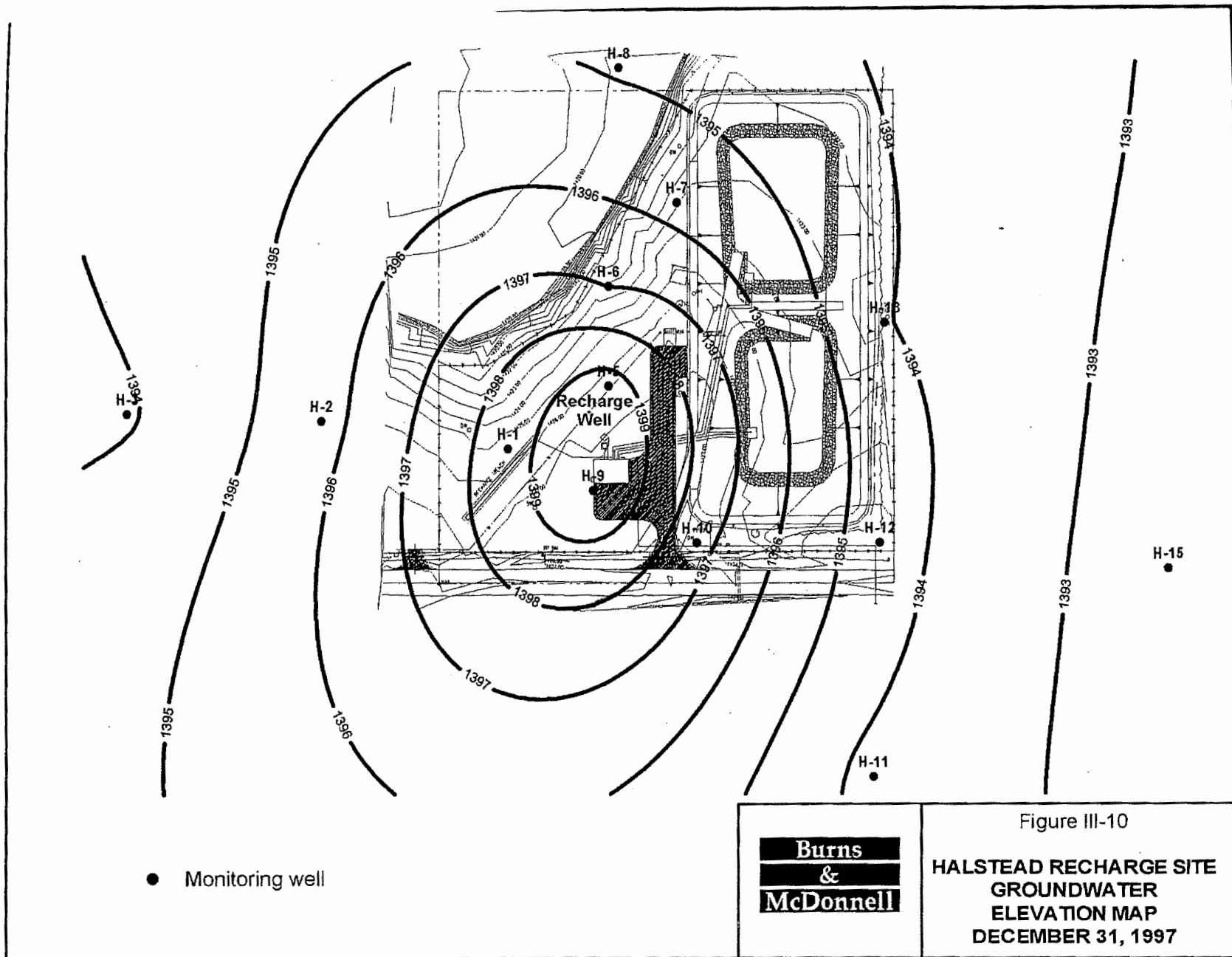
Projected transmission pipeline

**Burton  
IGUCA**

- Proposed aquifer storage and recovery well
- ▲ Non-domestic well or appropriation
- Domestic well
- Existing monitoring well
- Proposed monitoring well

**Attachment 45576-A. – Application No. 45576 Site Map - SW 12-23S-3W**  
Prepared by: Equus Beds Groundwater Management District No. 2 - 07/06/04





## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 17. the monitoring wells are drilled and completed at depths correlating to the upper and lower zones of the aquifer for water sample collection, water level measurements and testing purposes;**
- 18. the monitoring well sites are completed at spacing distances of 330 feet and 660 feet from the recharge and recovery well;**
- 19. water level monitoring at the recharge and recovery site shall be automated with a frequency not to exceed six hours;**



## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 20. before installation of the proposed ASR wells, the applicant shall submit to the District Board of Directors and the Chief Engineer, DWR; a water level and water quality monitoring plan for approval;**
- 21. the water quality monitoring plan shall provide all necessary chemical, physical, radiological and biological data, and include but not be limited to continuous monitoring of specific conductance, PH, turbidity, dissolved oxygen, temperature;**

## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 22. the proposed ASR wells are equipped with water meters to separately and accurately record the total flow of water injected and diverted from the ASR wells;**
- 23. the water meter installations shall comply with K.A.R. 5-22-4;**



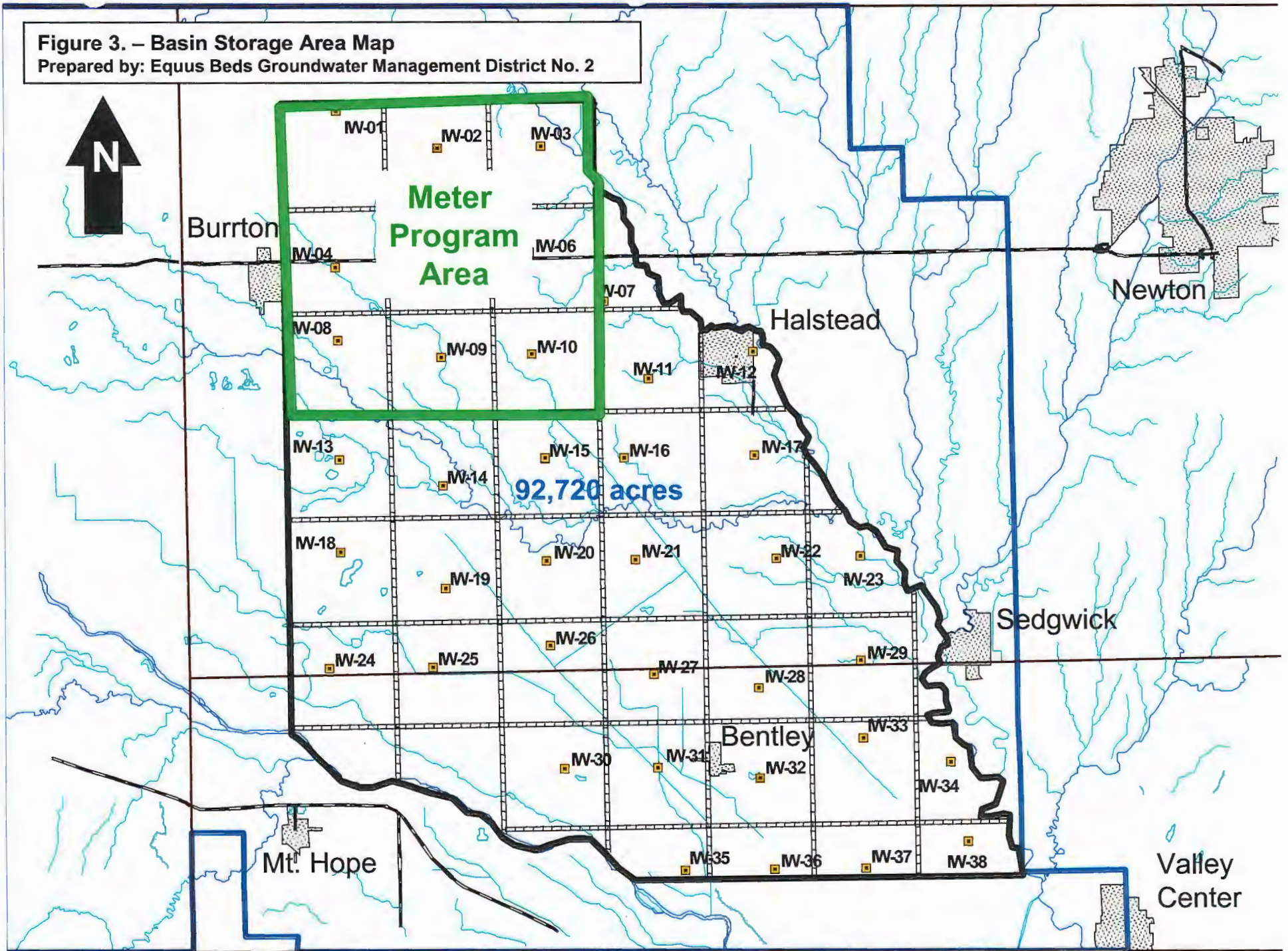
## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 24. the applicant shall make available to owners of non-domestic wells located within water budget accounting unit nos. 1, 2, 3, 4, 5, 6, 8, 9 and 10, a water metering program to provide flowmeters and limited installation cost reimbursement at the applicant's expense;**
- 25. the applicant's metering program will be made available for a minimum of 90 days;**
- 26. all non-domestic wells not metered under a previous requirement and located within water budget accounting unit nos. 1, 2, 3, 4, 5, 6, 8, 9 and 10, shall be equipped with water flowmeters by December 31, of the year following the application approval date and shall comply with K.A.R. 5-22-4;**



**Figure 3. – Basin Storage Area Map**  
Prepared by: Equus Beds Groundwater Management District No. 2





## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 27. the use of the proposed ASR wells are authorized by the Kansas Department of Health and Environment as Class V UIC wells and minimum water quality standards for effluent are approved by the Department for organic and inorganic compounds, pesticides and bacteria; the water recharged to the aquifer through the ASR wells shall comply with the source water regulation K.A.R. 5-1-1(sss);**
- 28. the water recharged to the aquifer shall either comply with EPA and KDHE safe drinking water standards, or meet the ambient water quality at the recharge sites, whichever is better, as determined by the Secretary of the Kansas Department of Health and Environment;**



## **STAFF RECOMMENDATIONS:**

**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

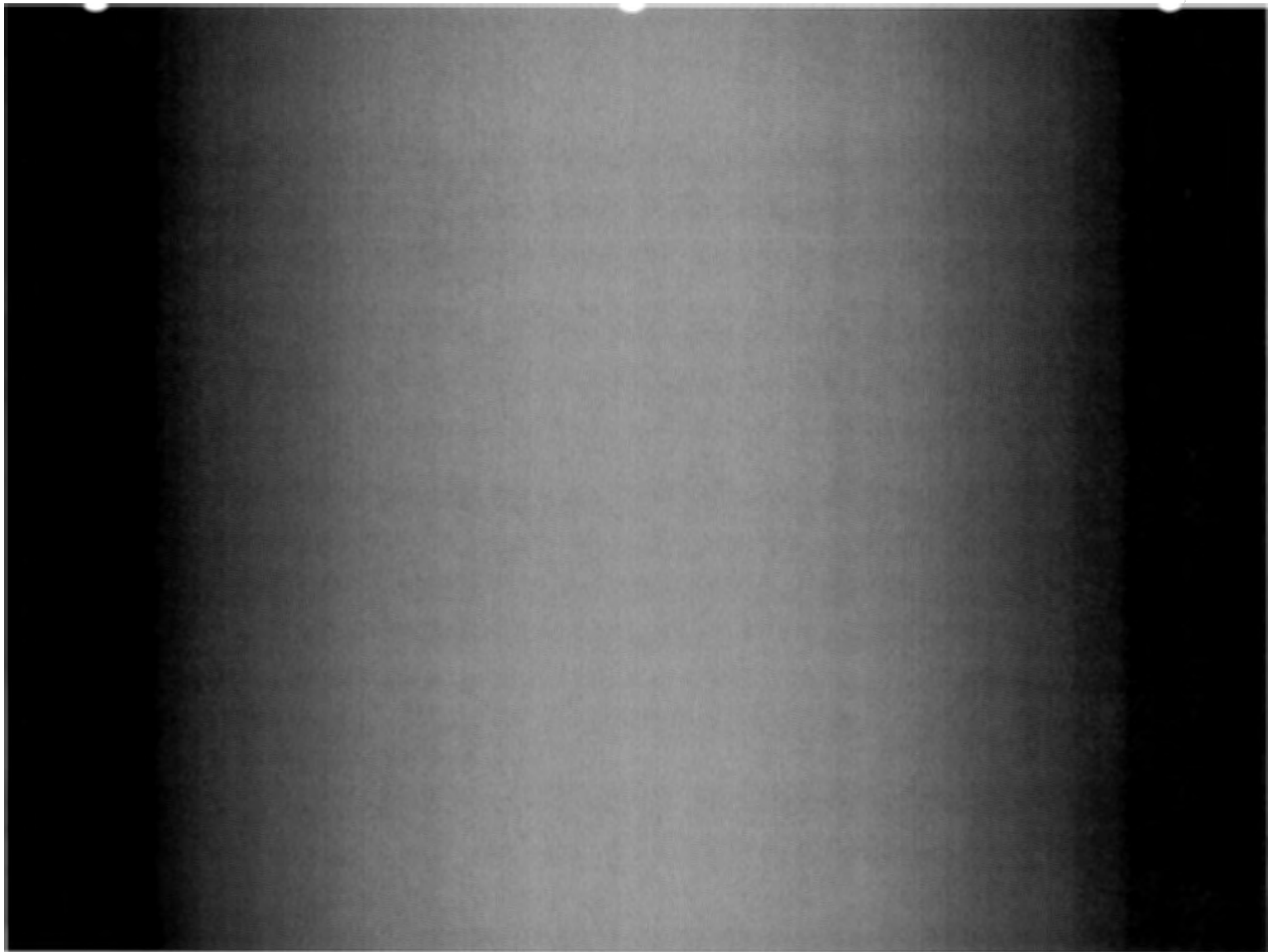
- 29. the quality of recharge water injected into the aquifer through the proposed wells shall not degrade the ambient groundwater quality in the basin storage area;**
- 30. to establish baseline ambient groundwater quality prior to bank storage withdrawal, water quality analyses shall be completed for samples collected from: a) domestic wells located within one-quarter mile of the proposed aquifer storage and recovery wells, b) the proposed ASR wells, and 3) all monitoring wells located at the ASR sites;**
- 31. the recharge system is constructed, operated and monitored to prevent groundwater contamination;**



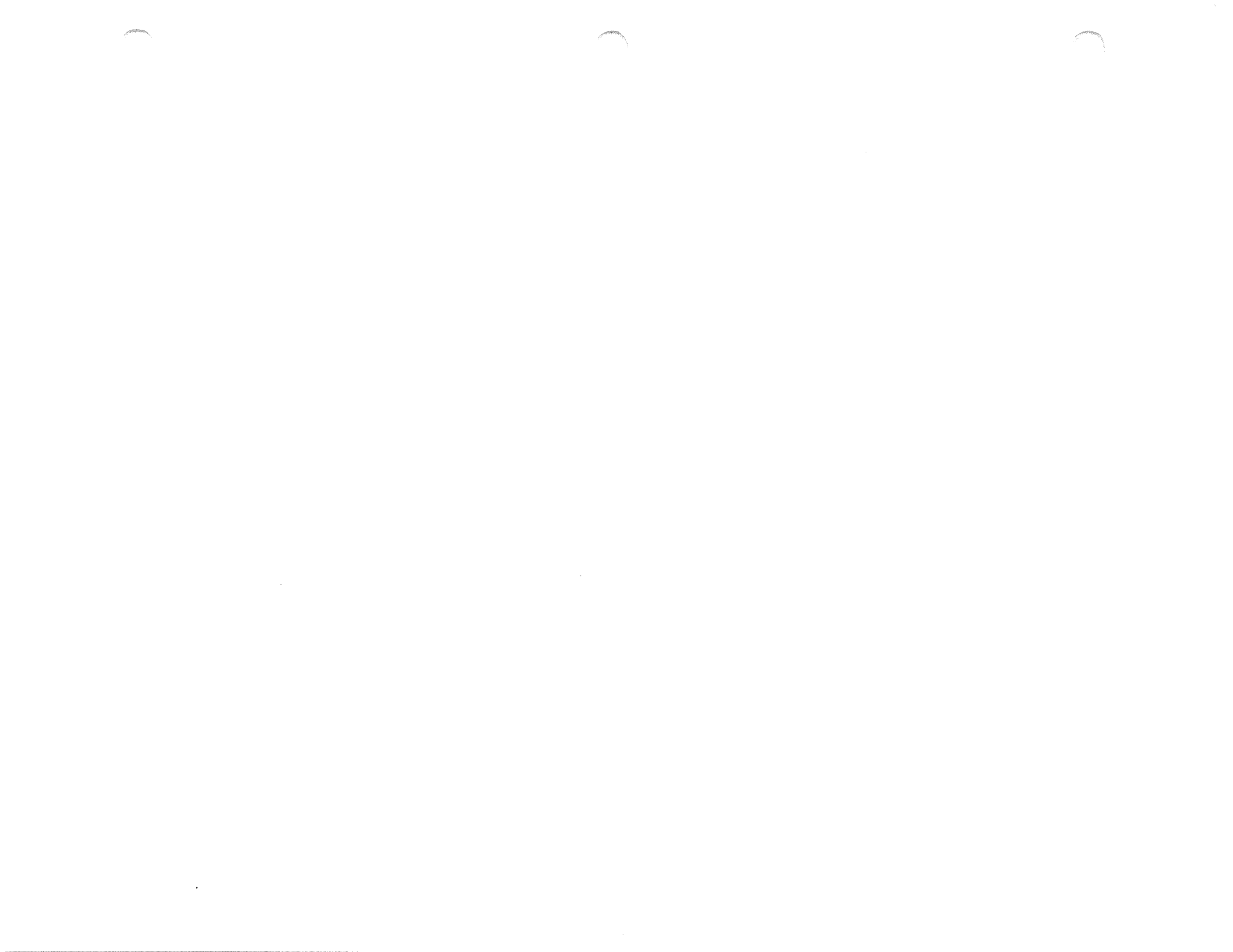
## **STAFF RECOMMENDATIONS:**

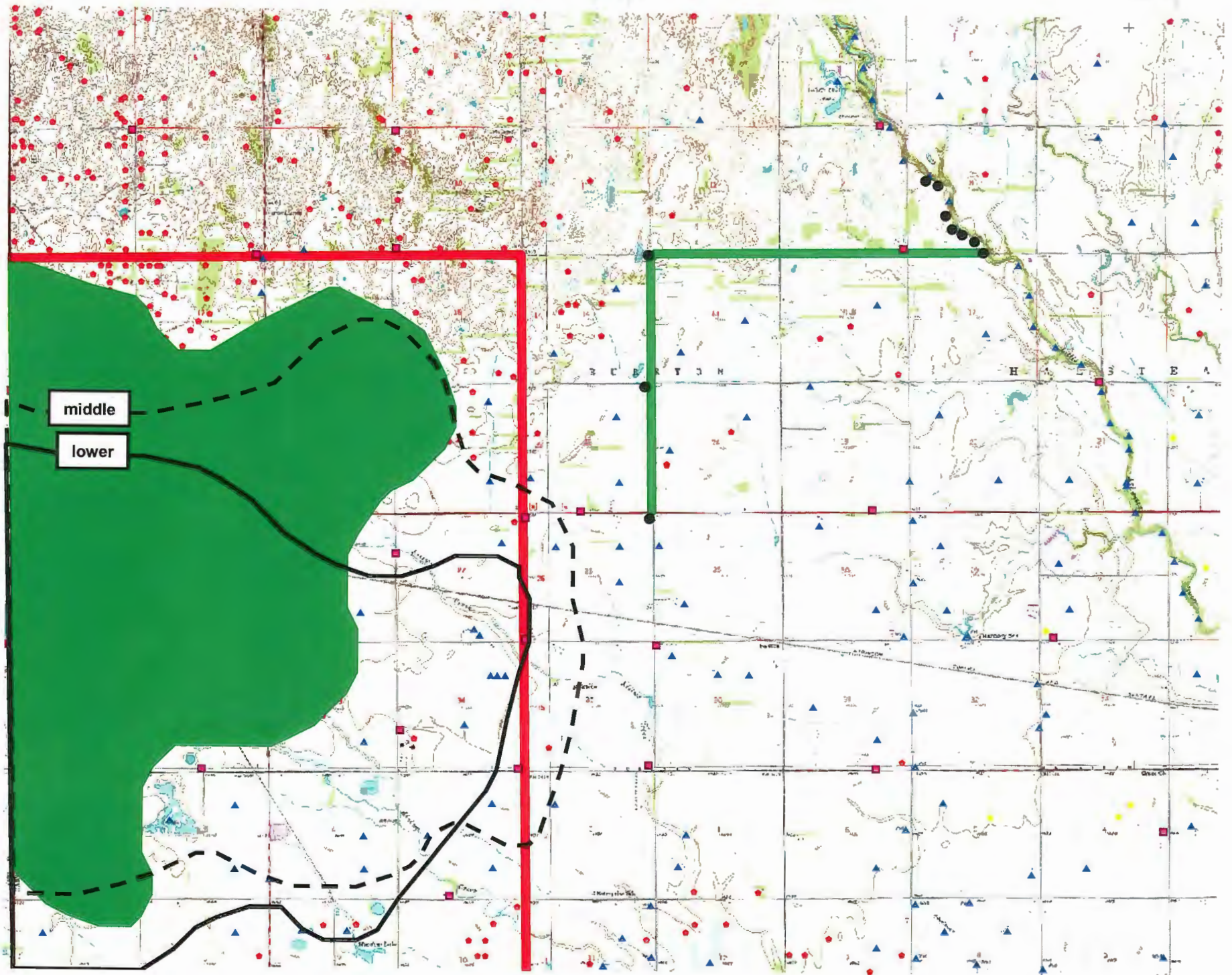
**Based on data submitted by the applicant and District findings, staff recommends that the applications be approved subject to conditions that:**

- 32. the applicant shall provide to the District a final report containing a description and scaled map of the as-built aquifer storage and recovery system;**
- 33. the diversion quantities, aquifer injection quantities, water level data and water quality analyses are reported to the Division of Water Resources and the District each month for the 1<sup>st</sup> year of operation, each calendar quarter for the 2<sup>nd</sup> year of operation, and annually thereafter by March 1, of each year; and**
- 34. the operation of the proposed ASR wells shall not impair existing water rights nor prejudicially affect the public interest.**

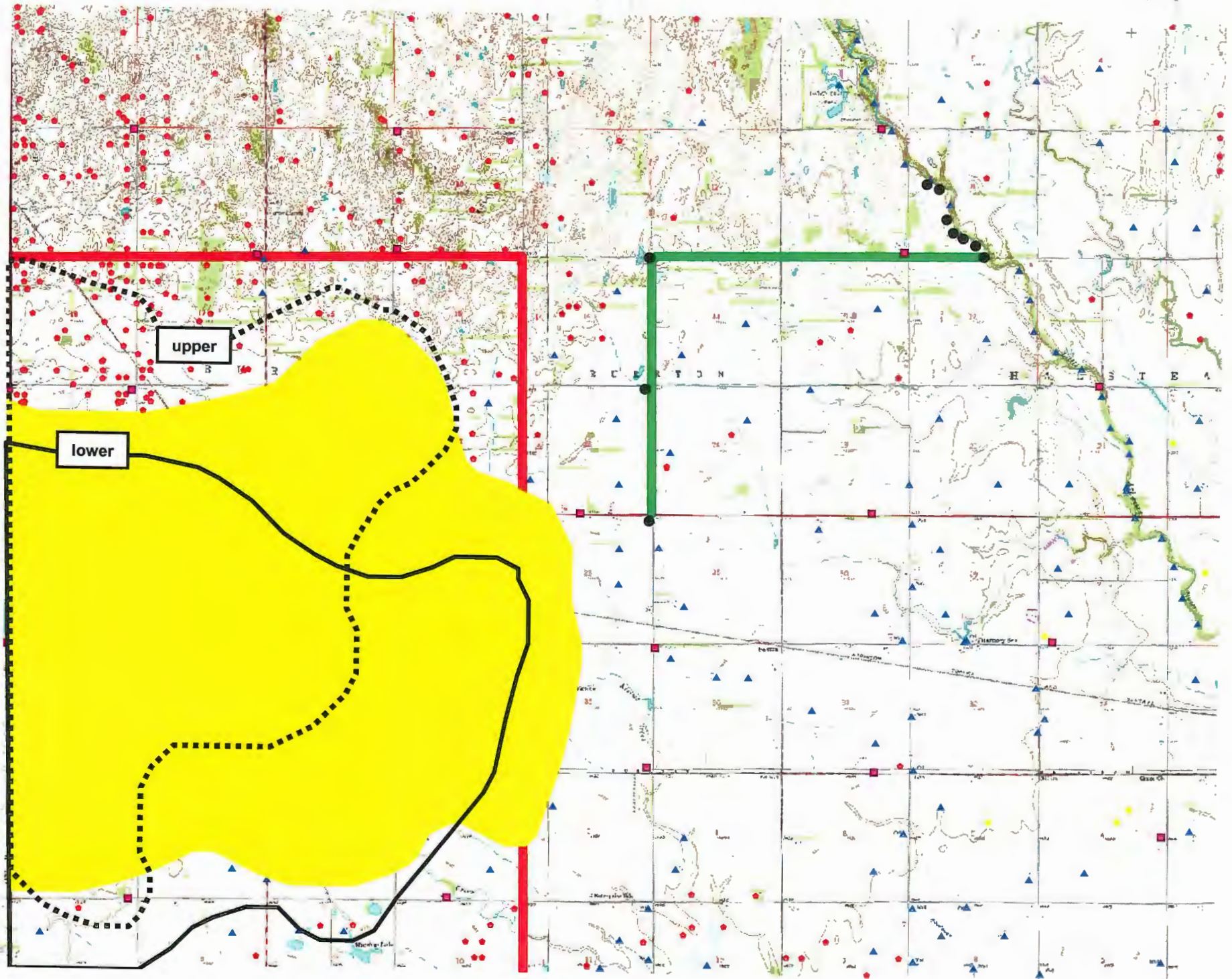












upper

lower



