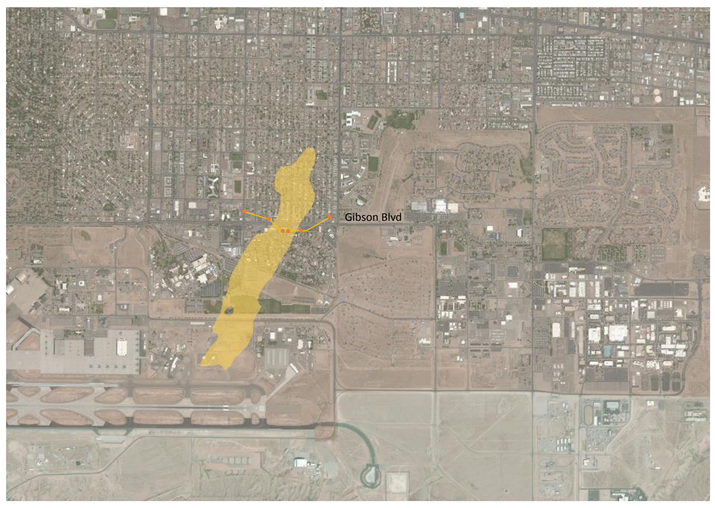
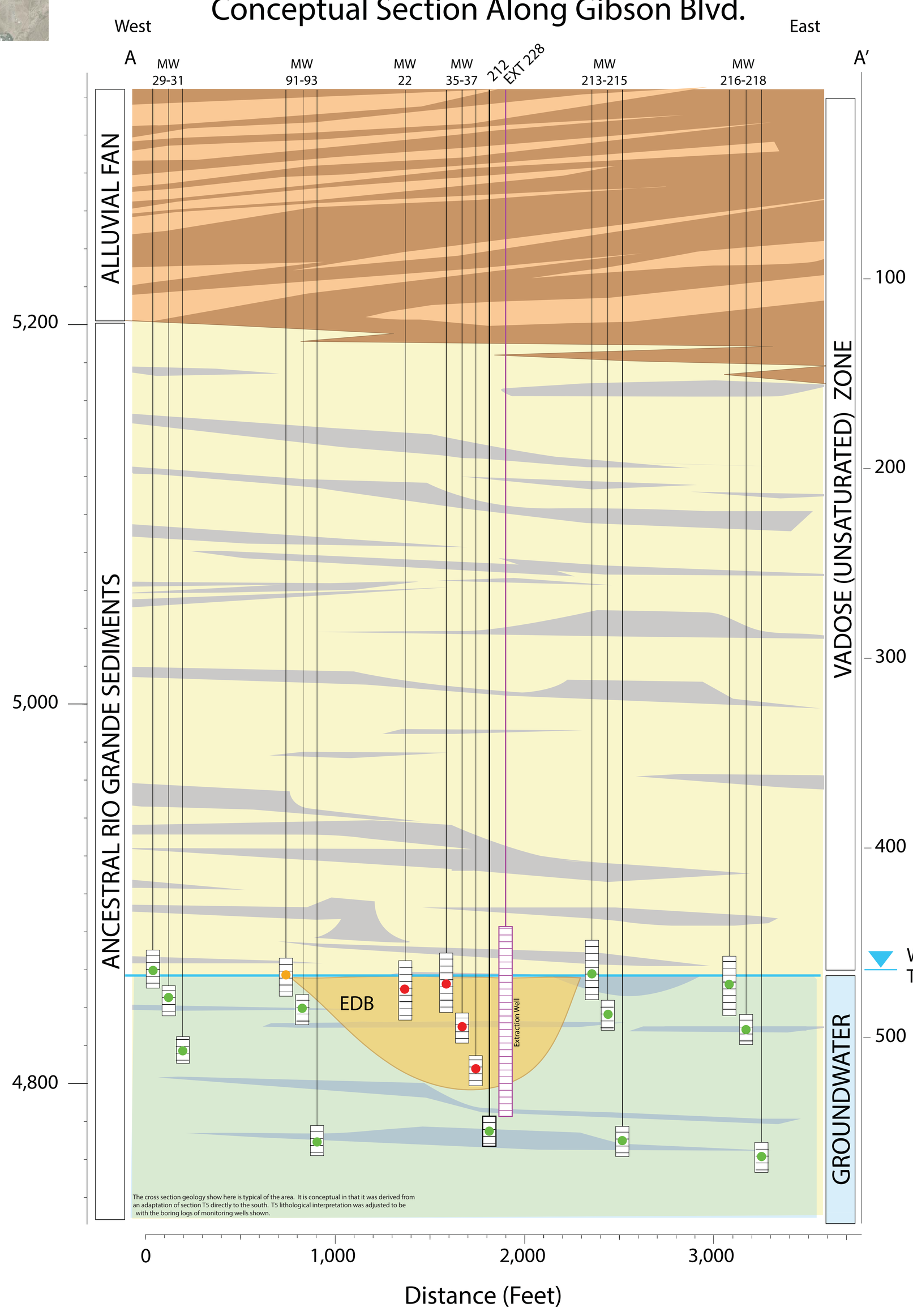
Defining the Subsurface:
Gibson Transect, First Extraction Well



Quarter 4 2015 Plume Map

Conceptual Section Along Gibson Blvd.

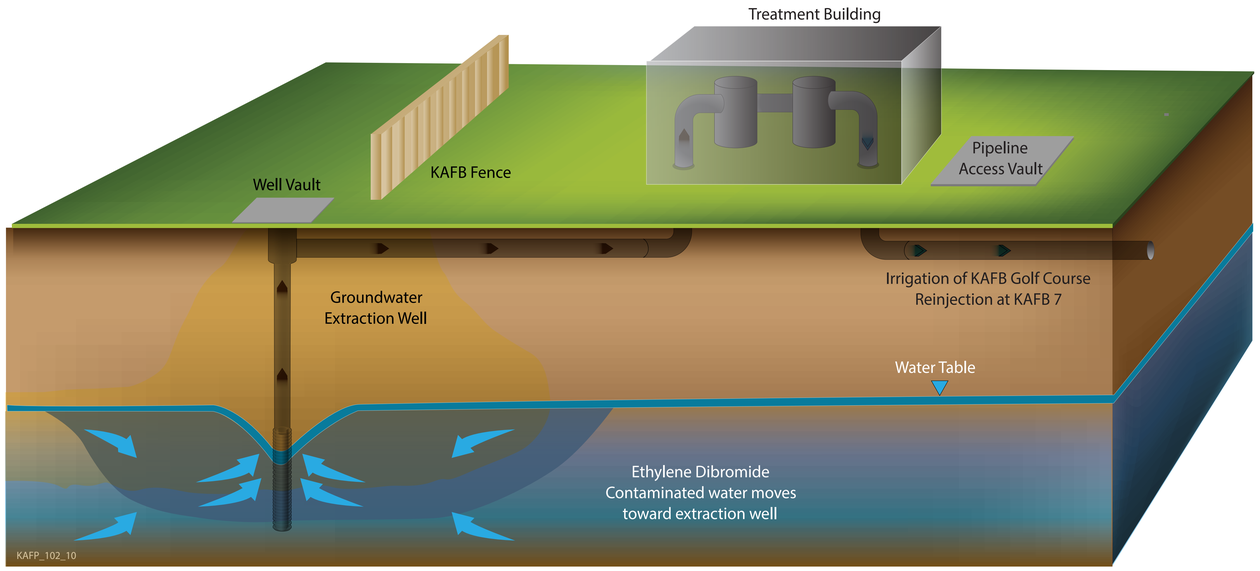


Conceptual Cross Section Key

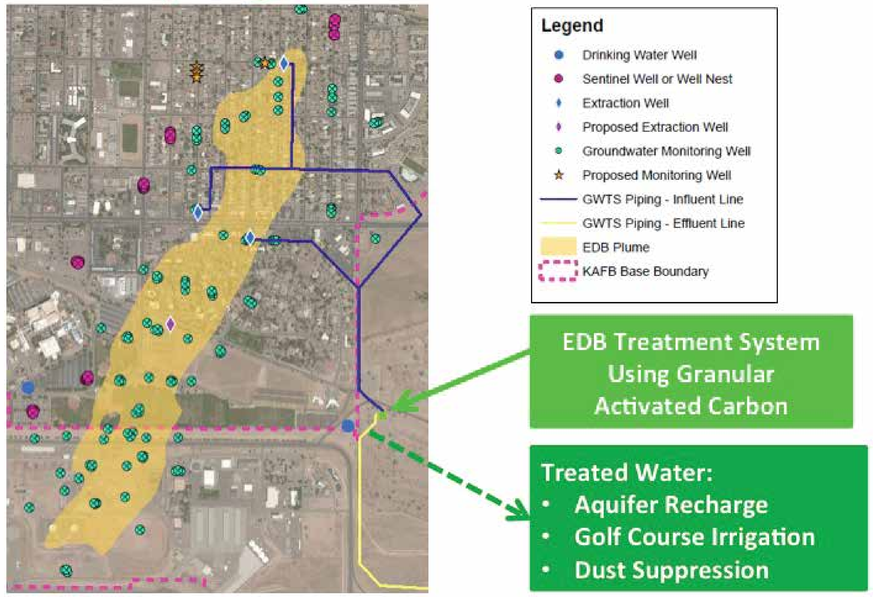
- Alluvial Fan Sediments
  - High Permeability
  - Low Permeability
- Ancestral Rio Grande Sediments
  - High Permeability
  - Low Permeability
- EDB Plume

Groundwater Treatment System

Example of a Pump & Treat System

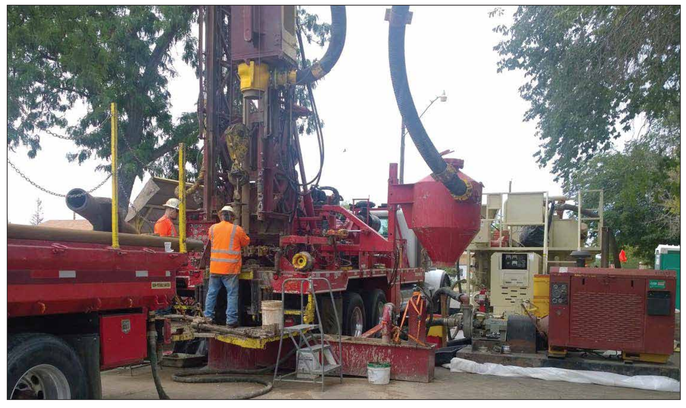


Collapsing the Dissolved EDB Plume



Quarter 4 2015 Sampling Results

Well 234 Driller inserting bit into well



Well 234 Drilling well in mud mode

Looking at split spoon for lithologic description

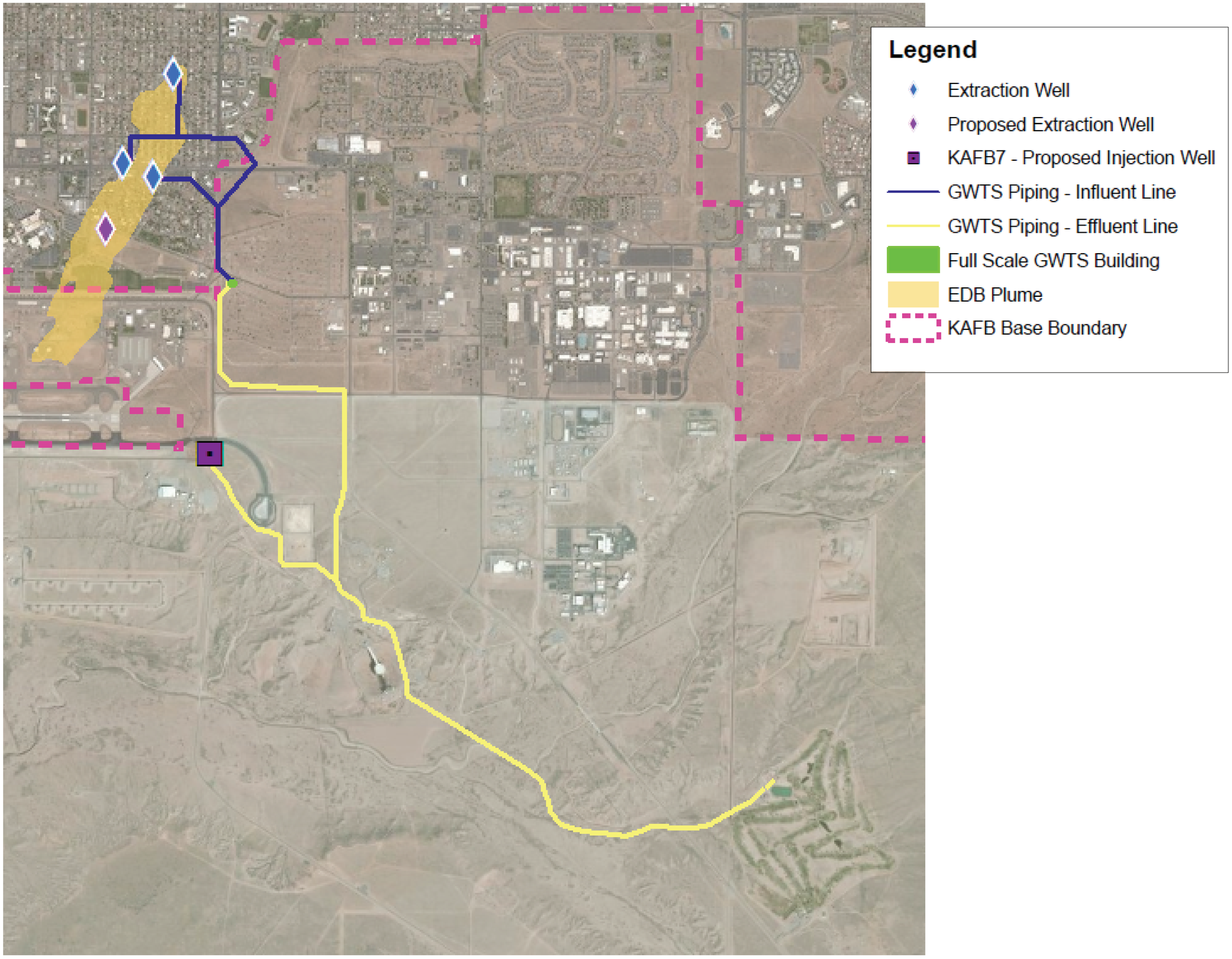
Directional drilling for installation of underground HDPE piping from extraction well KAFB-106228 to Kirtland AFB.

The GWTS began operation on December 31,2015 with all three extraction wells. The full-scale GWTS consists of an influent holding tank, bag filters, two-20,000 pound vessels containing granular activated carbon, and a treated water storage tank.

Fusing of the HDPE influent piping. This piping is being installed beneath the ground surface and connects the existing valve vault to the full-scale treatment building.

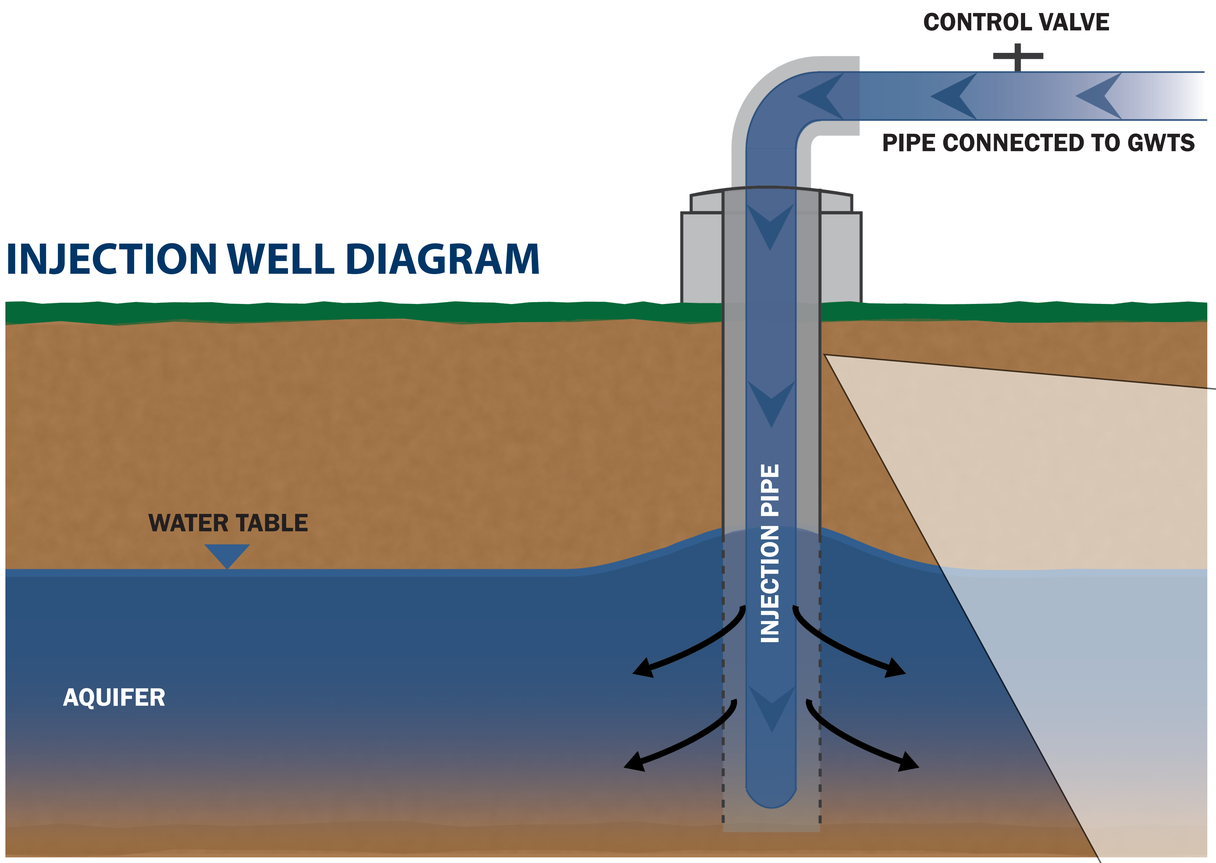
Granular activated carbon tanks used to treat contaminated water extracted from the plume.

Groundwater Treatment System Layout

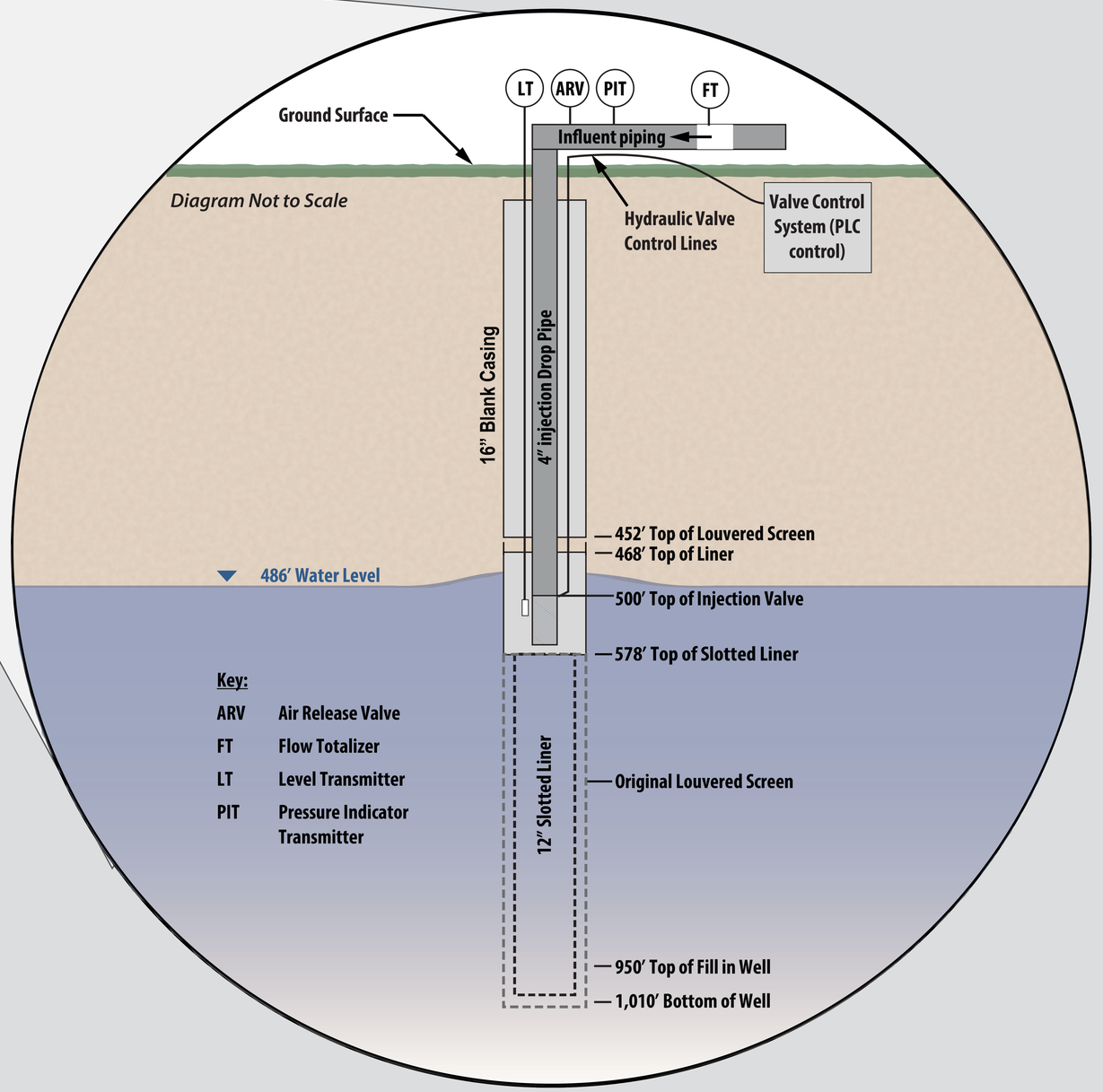


Gravity-Fed Injection of Treated Water

INJECTION WELL DIAGRAM



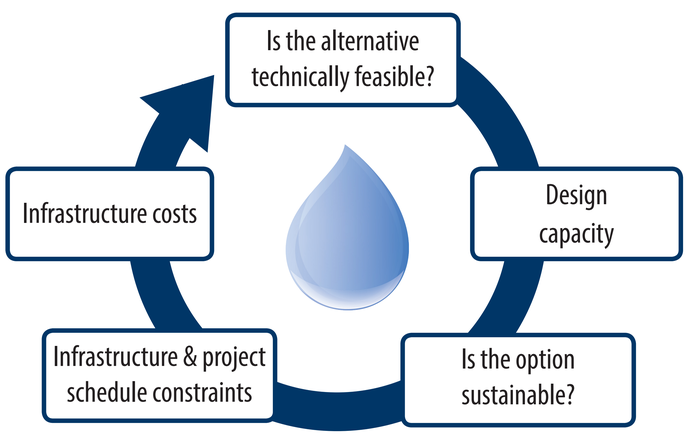
An injection well is used to place fluid underground into aquifers and/or geologic formations. In the case of the Kirtland AFB Bulk Fuels Facility leak project, the injection well is using gravity to drop treated water out of the bottom of a pipe, into the aquifer. The water has been treated to drinking-water quality and becomes part of the water in the aquifer. The volume and rate of water injected is controlled at the Groundwater Treatment System and is monitored with high-accuracy instrumentation to evaluate well and aquifer response to injection.



Beneficial Use of Treated Water

Different options (e.g., infiltration galleries, surface application such as irrigation, retention ponds, injection, etc.) are being considered for discharging water treated at the full-scale groundwater treatment facility.

These options are being evaluated using the beneficial reuse criteria below.



Based on our evaluation to date, which includes an understanding of how water moves through soil, two options were identified as viable options for discharging treated water: 1.) use of the Kirtland AFB Golf Course pond to hold water for irrigation use on the golf course; and 2.) a pilot scale test to inject water into the aquifer.

Regional Stratigraphy

West

East

Elevation (feet above MSL)

Distance on Section (ft.)

Vertical Exaggeration ~20X

QTsp

QTsa

Approximate Regional Aquifer

Approximate Perched Aquifer

EDB Plume

Outline of approximate area shown in section detail at bottom right

Fine-grained distal alluvial fan

Coarse-grained proximal alluvial fan

Coarse-grained ancestral Rio Grande deposits

Fine-grained ancestral Rio Grande deposits

A2

A1

?

Inferred Fault

Inferred Fault

KAFB-15 VA-2 KAFB-106081 KAFB-106067 KAFB-16 KAFB-0510 KAFB-0508 KAFB-7 KAFB-0507R KAFB-0505 KAFB-2627 KAFB-0509 KAFB-0506 KAFB-4 WYO-1, 2 WYO-3 TJA-6 TJA-3 TA2-W-28 TA2-W-24 TA2-W-25 ST-105MW020 KAFB-0901 KAFB-11

Graphic Grain Size Scale

Fine ——— Coarse

Clay
Clay with 10% Sand
Clay with 20% Sand
Clay with 30% Sand
Clay with 40% Sand
Gravelly Clay
Silt
Silt with 10% Sand
Silt with 20% Sand
Sandy Silt
Silty Sand
Clayey Sand
Silty Sand (Fine Sand with 40% Fines)
Clayey Sand (Fine Sand with 40% Fines)
Silty Sand (Fine Sand with 30% Fines)
Clayey Sand (Fine Sand with 30% Fines)
Silty Sand (Fine Sand with 10-20% Fines)
Clayey Sand (Fine Sand with 10-20% Fines)
Gravelly Silt
Fine Sand
Silty Sand (Medium Sand with 50% Fines)
Clayey Sand (Medium Sand with 50% Fines)
Silty Sand (Medium Sand with 40% Fines)
Clayey Sand (Medium Sand with 40% Fines)
Silty Sand (Medium Sand with 30% Fines)
Clayey Sand (Medium Sand with 30% Fines)
Silty Sand (Medium Sand with 10-20% Fines)
Clayey Sand (Medium Sand with 10-20% Fines)
Fine Sand with Gravel
Medium Sand
Silty Sand (Coarse Sand with 50% Fines)
Clayey Sand (Coarse Sand with 50% Fines)
Silty Sand (Coarse Sand with 40% Fines)
Clayey Sand (Coarse Sand with 40% Fines)
Silty Sand (Coarse Sand with 30% Fines)
Clayey Sand (Coarse Sand with 30% Fines)
Silty Sand (Coarse Sand with 10-20% Fines)
Clayey Sand (Coarse Sand with 10-20% Fines)
Fine Sand with Gravel
Coarse Sand
Coarse Sand with Gravel
Clayey/Silty Gravel
Sandy Gravel
Fine-Coarse Gravel

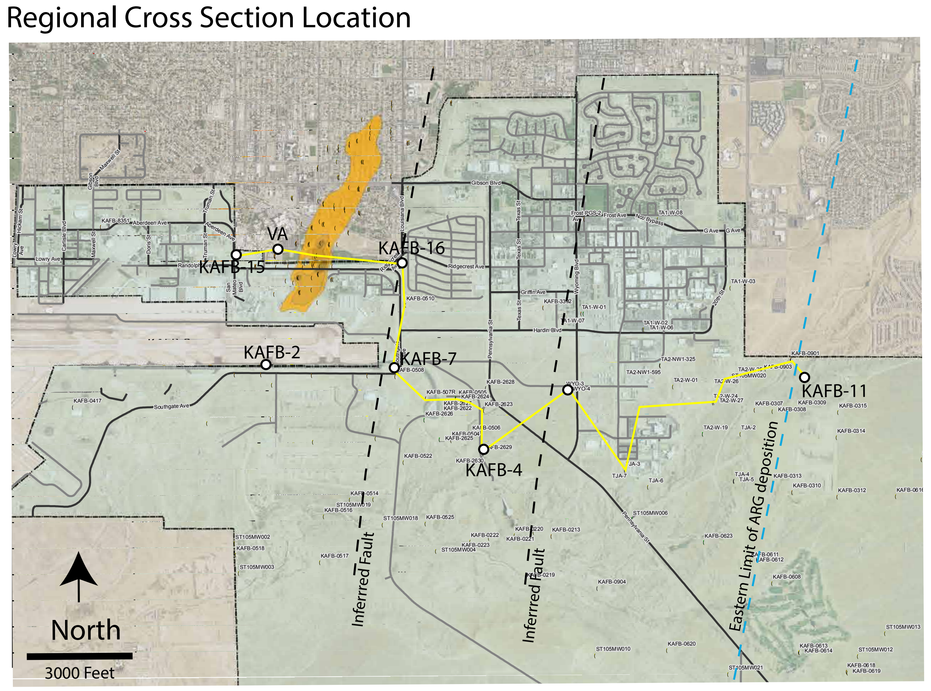
QTsp: Alluvial Fan

- Proximal fan (coarse relative grainsize)
- Distal fan (finer relative grainesize)

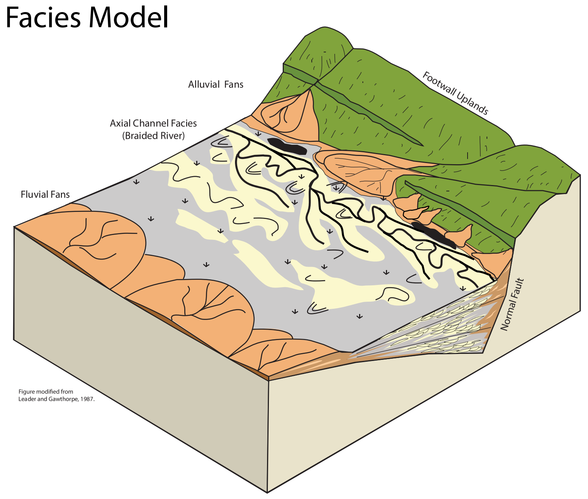
QTsa: Ancestral Rio Grande

- Braided river deposits (high % sand and gravel)
- Fine grained deposits potential change in river morphology indicated

Regional Cross Section Location



Facies Model



LithoFacies Key (Model and Inset Section)

High Transmissivity Facies (High Permeability Sediments)

Alluvial fan distributary channel fills and sheet flood deposits: Angular and subangular gravel and sand mixtures that correspond to piedmont member of Sierra Ladrones Formation in east, potentially the Ceja formation in the west.

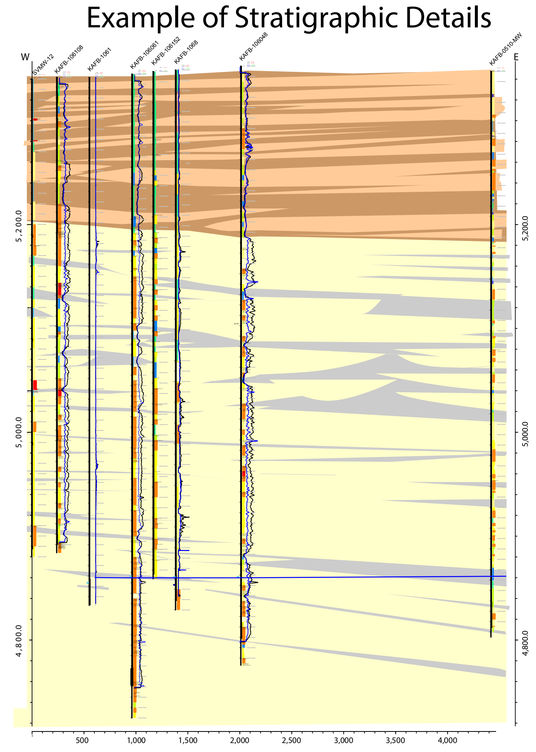
Braided River Deposits: Rounded and subrounded gravel and sand mixtures deposited as channel fills, lenticular bars, and splay (coarse overbank) deposits. Thick zones (>20ft) likely consist of discrete, closely stacked fining upward packages of sediment. Sediments correspond to the axial-fluvial member of the Sierra Ladrones Formation.

Low Transmissivity Facies (Low Permeability Sediments)

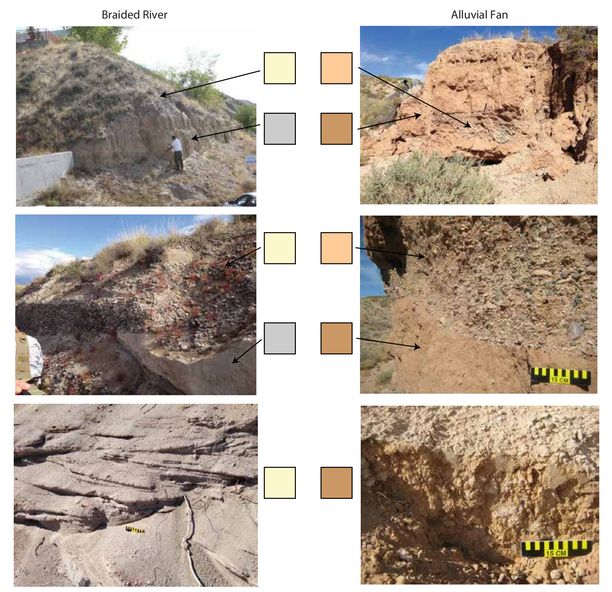
Alluvial fan distal deposits and interdistributary fill: Fine grained fan material consisting of silts and silty, sandy clay.

Braided River Dep osits: Overbank , chute fill, and backwater deposits consisting of silty sands, silts, and clays.

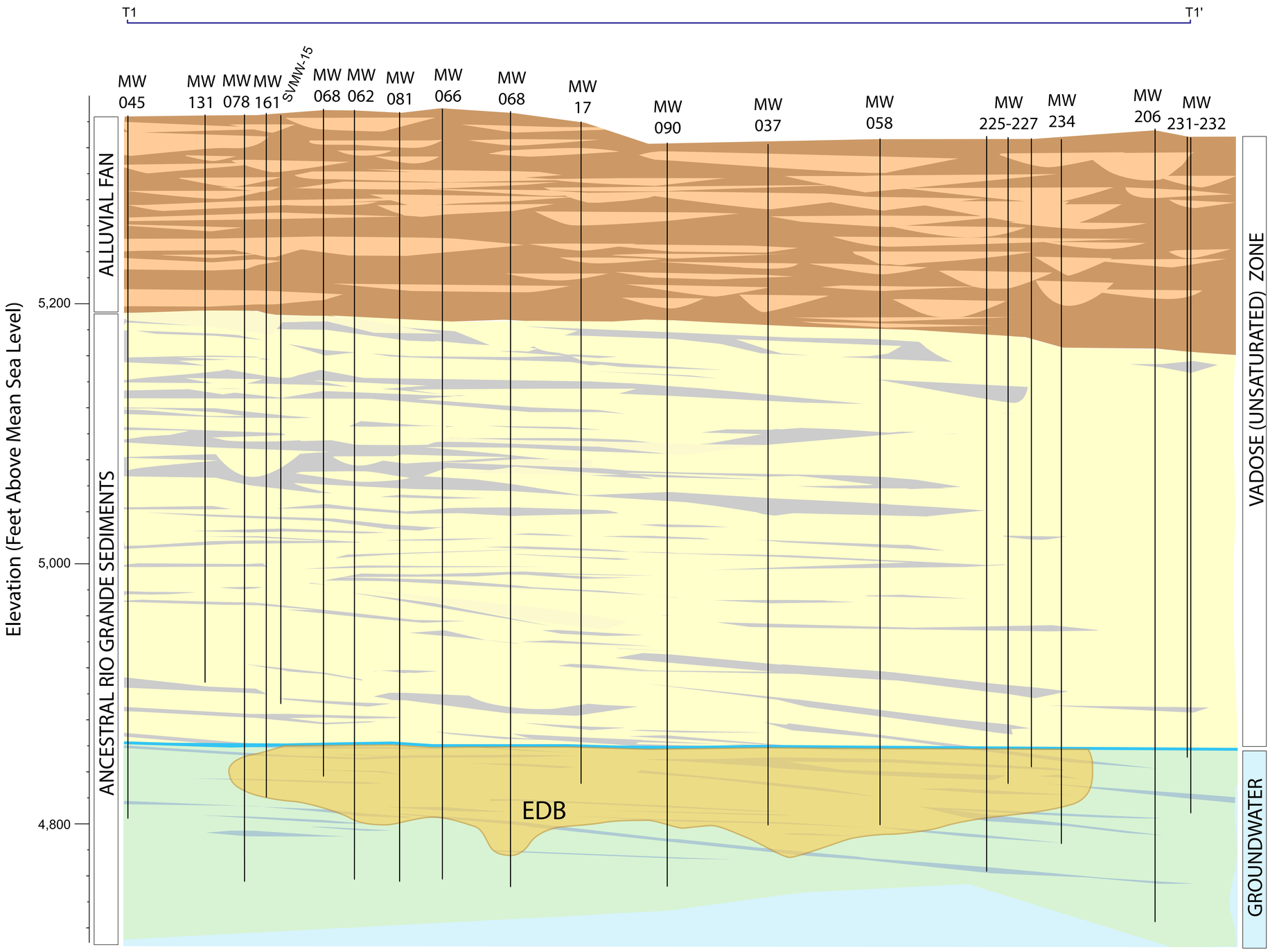
Example of Stratigraphic Details

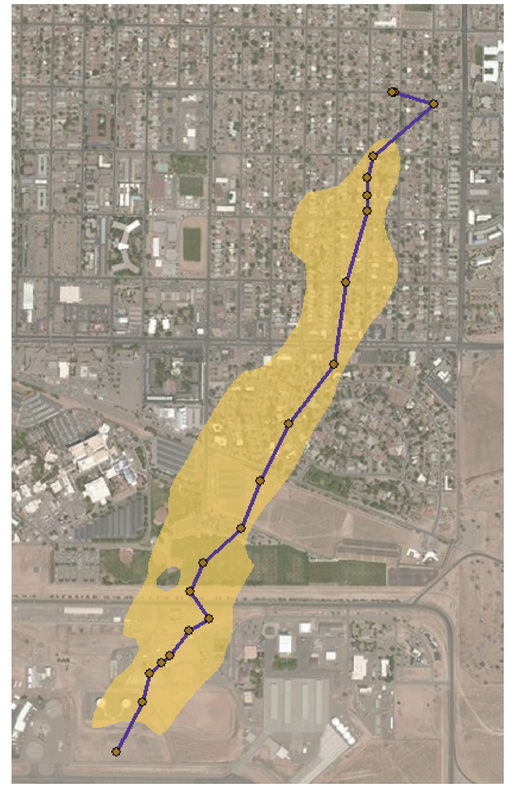


Outcrop Examples Of Facies Types



Transect Along EDB Plume





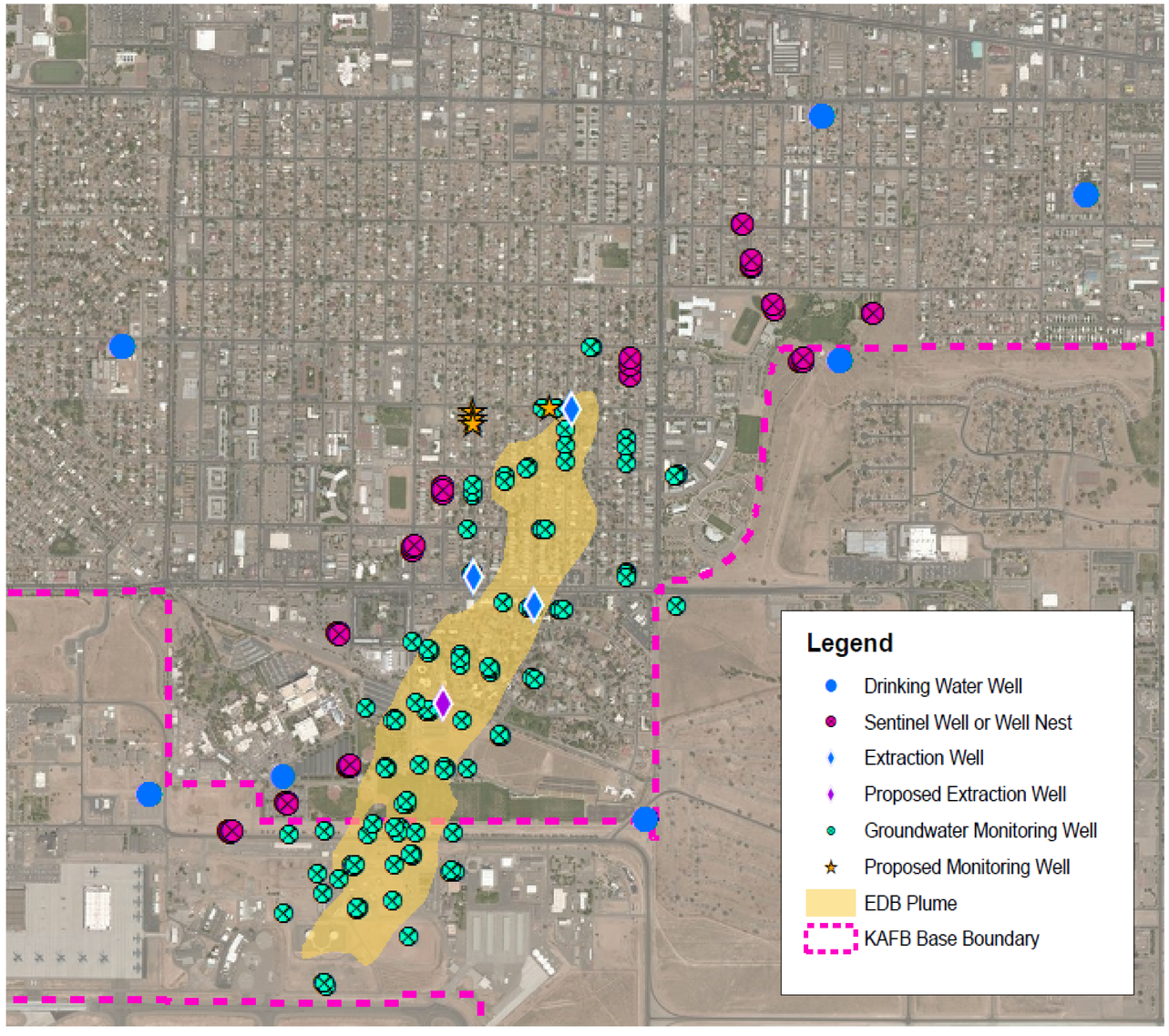
KAFB Q4 2015 EDB Plume - PLAN with Revised T1

0 400 400 800
HORIZONTAL SCALE IN FEET

0 40 80 160
VERTICAL SCALE IN FEET
Vertical Exaggeration = 10X

What is Ethylene Dibromide (EDB)?

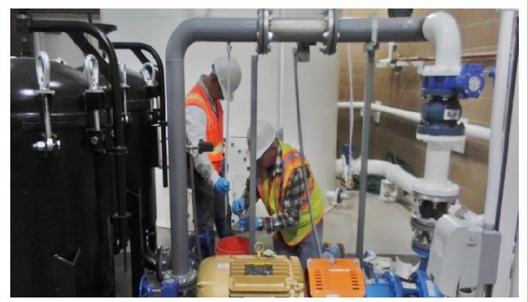
- EDB is a synthetic chemical that has been used as a lead scavenger in aviation gas and leaded gasoline. EDB was also used as a fumigant in agriculture.
- EDB was in aviation gas that was used at Kirtland Air Force Base.
- Fuel leaked into the ground and contaminated groundwater.
- EDB is a known carcinogen and is regulated at 0.05 µg/L (parts per billion) by the U.S. Environmental Protection Agency and the New Mexico Environment Department.
- EDB has not been detected in Albuquerque drinking water supply wells.



Quarter 4 2015 Sampling Results

How We Collect a Water Sample

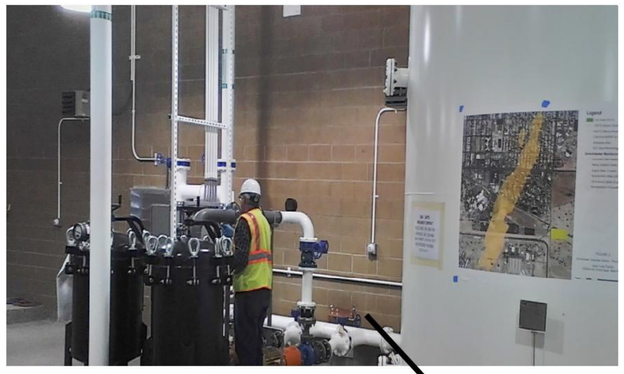
Performance Sampling of Groundwater Treatment System

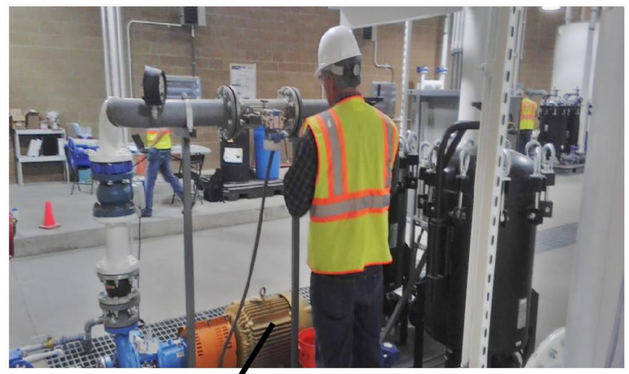


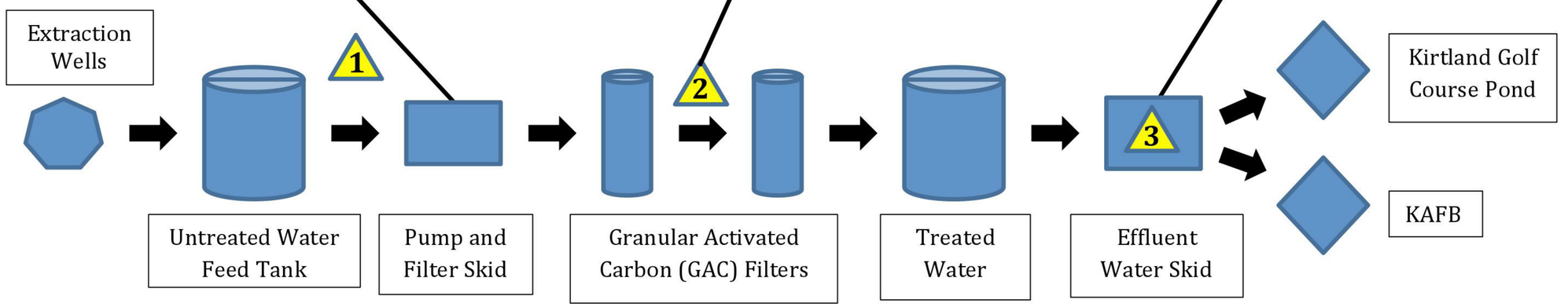
Sample Point 1: Sample of untreated water from extraction wells.

Sample Point 2: Water sample obtained between GAC filters, after passing through the first filter of the treatment system.

Sample Point 3: Water sample taken after second GAC filter of the treatment system. The design goal of the treatment system is no detection of fuel constituents and the regulatory requirement is drinking water standards.







What we sample the groundwater for:

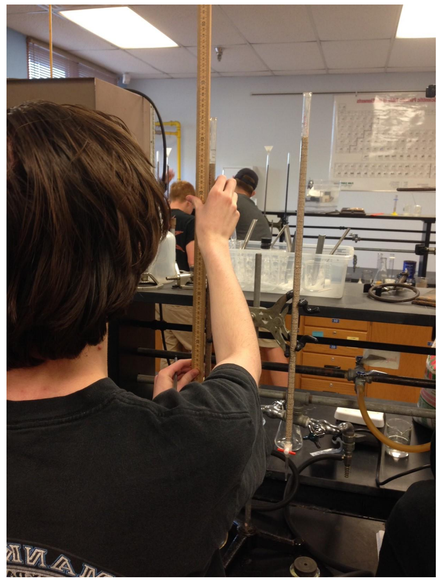
Laboratory Analysis: EDB (ethylene dibromide), volatile organic compounds including benzene, toluene, ethylbenzene, and xylenes (BTEX), dissolved iron, and dissolved manganese

Field Measurements: pH, temperature, specific conductance, dissolved oxygen, oxygen reduction potential, and turbidity

Highland High School
Advanced Placement Chemistry

HIGHLAND HIGH SCHOOL
HOME OF THE HORNETS

OBJECTIVE:
To purify a solution, which was water thoroughly mixed with compost.



EXPERIMENTAL DESIGN – WHY DID WE DO WHAT WE DID?

Our experimental design was originally designed to expose the contaminated water (water that had been mixed with organic compost and chlorine) to the three filters (activated carbon, sand, and kitty litter) for a set time of 14 minutes without suction and take whatever had been filtered to be tested. This model had to be adapted because of several obstacles that occurred throughout the experiment.

METHODS/PROCEDURE:

The original test procedure went as follows:

1. Gather 100 ml of filtering agents into 100 ml pipettes (e.g., cat litter, sand, and carbon).
2. Be assigned to 25%, 50%, or 75% polluted solution.
3. Gather 100 ml of (25%, 50%, or 75%) polluted solution into a 100 ml beaker (for more accurate results).
4. Prepare timer on phone or stopwatch (to either count up to 14 minutes or down to zero from 14 minutes being the start time.) After Step 4, we decided to hook up a flask with a rubber cork that was linked to a faucet where the water pressure will cause suction to the pipette and cause the solution to filter forcibly.
5. Begin to pour assigned solution down each of the three filtering agents while tracking passing time. *Modification: Attach flask with rubber cork underneath the pipette.*
6. Note: Some polluted solution will drop out of the pipette and not into the collecting flask which will result in some loss of solution. *Modification: Link a tub from the flask to the faucet an turn on water that is running into the sink.*
7. Continue with filtering until all 100 ml is filter through each filtering agent, record what amount of polluted solution was filtered at the 14-minute minimum. *Modification: Immediately, the pressure from the water will cause the suction.*

WHAT DID WE LEARN?

- Good experimental design has to be constantly monitored and modified to meet the needs of the experimenter as problems arise.
- The Burette tips were getting clogged so we inserted small circles of filter paper to prevent the san from falling into and clogging the tips.
- When attempting to test the solution for a chemical, it is very important to know how long from sample collection to testing a component stays in solution. Chlorine must be tested within 20 minutes or the data will be unreliable.
- In order to increase flow through a filter media, filter flasks can be attached and used in conjunction with faucet aspirators to create a low pressure in the flask which will pull the filterate through the filter.
- When doing a real experiment, things go wrong and procedures must be modified with notes to that the modifications can be included in the final procedural report.