CLASS V INJECTION WELL APPLICATION FOR SUBSURFACE INJECTION OF NON-WASTE FLUID BELOW THE LOWER MOST USABLE WATER ZONE

Submit to:
Kansas Department of Health & Environment
Division of Environment
Bureau of Water
Geology Section
1000 SW Jackson St, Suite 420
Topeka, Kansas 66612-1367

Owner's Name, Telephone Number,
Mailing and E-Mail Addresses:

_____
_____
_____
_____

Operator's Name, Telephone Number,
Mailing and E-Mail Addresses:

_____
_____
_____
_____

Contact Person's Name and Mailing Address:

_____
_____
_____
_____

Date of Application: _____
KDHE UIC Permit No.: _____
Well(s)# _____

Legal Description: ____ 1/4 ___ 1/4 ___ 1/4
_____ Sec. _____, T _____ S, R _____ (E) (W)
_____ feet from south line of SE/4
_____ feet from east line of SE/4

County _____

G.P.S. Coordinates:
Latitude _____ Longitude _____

Located on Indian lands: Yes____ No_____

Facility Name, Telephone Number, Mailing and
E-Mail Addresses:

_____
_____
_____
_____

Contact Person's Information:

Phone: _____
Fax: _____
E-Mail: _____

In conformity with the provisions of K.S.A. 65-171d, the undersigned, representing

_____

(Name of company, corporation, partnership, or person, or government or other public agency applying) hereby makes application to KDHE for a permit to dispose of liquid wastes into the subsurface by means of a disposal well.

The application should address the following items in numerical order.

1. Provide documentation all required local approvals have been obtained.

2. List any permits or construction approvals received or applied for by the facility which are required under any of the following programs

   - Hazardous Waste Management program under the Resource Conservation Recovery Act (RCRA).
   - Underground Injection Control program under the Safe Drinking Water Act.
   - National Pollutant Discharge Elimination System program under the Clean Water Act
   - Prevention of Significant Deterioration (PSD) program under the Clean Air Act
   - Nonattainment program under the Clean Air Act
   - National Emission Standards for hazardous Pollutants (NESHAPS) preconstruction approval under the Clean Air Act.
   - Dredge and fill permits under section 404 of Clean Water Act.
   - Other relevant environmental permits, including State permits.

3. Describe in detail the purpose of this injection well.

4. Describe all fluid to be injected, including physical, chemical, bacteriological and radiological properties and toxicity. Provide analyses for each injection stream including analyses for all constituents listed in Attachment A. Include Material Safety Data Sheets (MSDS) for any additives used. All analyses shall be conducted by a laboratory certified by the State of Kansas. Additional testing of the injection stream may be required after review of the application and pertinent information.

5. Describe the sources, including individual processes, generating the various fluid streams that are proposed to be injected. Provide a block flow diagram depicting the relationship of the sources to the proposed injection well. Include all sources and estimated quantities of fluid produced by each source. An example of an acceptable diagram format is attached.

6. Provide the following: (**Guidance for completing this section - Procedure #UICV-12, Procedure for Completing Section #5 of the Permit Application for a Class V Injection Well can be found at www.kdheks.gov/uic/download/.)**

   Note: Seismic data may be necessary to characterize the subsurface geology if there is insufficient well control in the area.

   a. Provide discussion and supportive information demonstrating drilling the injection well and injecting fluid into the subsurface stratum will not endanger or injure any mineral resources (coal, oil, gas, salt, sand, gravel, others) bearing formations. Include maps and sources for other supporting information.

b. A map indicating the boundaries and ownerships of tracts of land adjacent to the applicant's facility boundaries. Include a list of the names and mailing addresses of all owners of tracts of land adjacent to the plant boundaries keyed to the map.

c. A USGS topographic map indicating the facility boundaries and well location. Include on this map an outline of the 0.25 mile radius area of review. If the cone of influence calculated in part q. of this section is greater than the 0.25 mile radius area of review, then the cone of influence area of review applies.

d. Provide a clear, legible, detailed map with an appropriate scale. The 0.25 mile radius area of review must be drawn on the map. If the cone of influence calculated in part q. of this section is greater than the 0.25 mile radius area of review, then the cone of influence area of review applies. The following, if present within the area of review, must be shown on the map.

- the injection well to be permitted
- all oil and gas producing wells
- all inactive wells
- injection wells
- abandoned wells
- dry holes
- plugged wells
- core holes
- surface water bodies
- springs
- mines
- quarries
- water wells
- monitoring wells
- faults
- linaments
- other pertinent surface features

Provide a tabulation of data for all wells penetrating the injection zone and/or the confining zone within the area of review including the following:

- current status
- type
- construction
- date of drilling
- location
- depth
- plugging or completion data

Key these wells to the map. Copies of plugging records for wells penetrating the injection zone and/or the confining zone shall be provided if available. **A schematic indicating the current configuration of all wells penetrating the injection zone and/or confining zone shall be submitted.** Provide proposed corrective measures required for wells in the area of review, if any.

e. Describe the protocol used to identify, locate and ascertain the condition of all wells within the area of review. At a minimum the records of the following shall be reviewed:

- Kansas Department of Health and Environment
- Kansas Geological Society
- Kansas Geological Survey
- Kansas Corporation Commission

Provide documentation that these sources were checked. Appropriately scaled aerial photos of the area of review shall also be examined for any indication of wells and the results reported. Copies of the aerial photos examined shall also be submitted. In addition, the location of each abandoned well penetrating the injection zone shall be physically inspected. The results of this inspection shall be documented and submitted to KDHE.

f. Provide surface geologic maps, cross sections, and structural contour maps illustrating the regional geologic setting.

g. Provide two cross-sections perpendicular to each other crossing at the proposed injection well location. These cross-sections shall include, at a minimum, available wire-line logs, geologic units and lithology from the surface to the base of the injection zone. The lines of the cross-sections should be shown on all structure maps. The cross-sections should contain the well numbers from the area of review map for reference.

h. Provide maps and cross-sections indicating the general vertical and lateral limits of all aquifers containing less than 10,000 mg/l total dissolved solids within the area of review, their position relative to the zone of injection and the direction of water movement if known. (i.e. groundwater flow map) All maps should include the area of review.

i. Provide detailed discussion of the nature and areal development of upper and lower confining strata (lithology permeability, etc.).

j. Provide descriptions and maps of faulting and fracturing or lineations in the area and discussion of the seismic history and activity of the area.

k. Provide depositional and structural history of the area including lithology and hydrologic properties of all units penetrated by the proposed well.

l. Provide the following maps for the area using available well control:

- Structural contour map of the injection zone
- Isopach map of the injection zone
- Structural contour map of the confining zone
- Isopach map of confining zone

m. Provide a piezometric surface map of the injection zone or, if insufficient data is available, provide the expected static fluid level and regional gradient. Reference sources of this information and include the area of review on the map.

n. Provide a description of porosity, permeability, and temperature of the injection interval and chemical characteristics of the injection interval fluid. Reference sources of this information.

o. Provide the predicted fracture pressure of injection interval. Provide the calculations and methodology used to determine the fracture pressure. Reference the sources of values used. One example of an acceptable equation for calculating the predicted fracture pressure is the Eaton Equation, as follows:

$$F = \left(\frac{S-P}{D}\right)\left(\frac{v}{1-v}\right)+\frac{P}{D}$$

P = wellbore pressure, psi
D = depth, ft
S = overburden stress, psi
v = Poisson's ratio
F = fracture gradient, psi/ft

p. Calculate the predicted injection zone pressure build-up within a 0.25 mile radius of the proposed injection wellbore. Provide a pressure contour map for the area of review. Include calculation, equations, parameters and sources of information used to arrive at the predicted pressure build-up. This should be calculated for the expected life of the injection well. The effects of other wells injection into the same injection zone within the vicinity of the proposed well shall also be considered.

q. Calculate the cone of influence. Provide a map showing the cone of influence. The cone of influence is defined as that area around the well within which increased injection zone pressures caused by injection into the injection well would be sufficient to drive fluids into a source of fresh and usable water. Include calculations, equations, parameters, and sources of information used to determine the cone of influence. This should be calculated for the expected life of the well.

r. Calculate the predicted distance of injected fluid flow from the injection well. Include calculations, equations, parameters and sources of information used. This should be calculated for the expected life of the well. An acceptable equation for calculating this comes from Warner and Lehr, Subsurface Wastewater Injection, Premier Press, 1981 and is as follows:

$$r = \sqrt{\frac{V}{\pi b \varphi}}$$

r = radial distance of wastewater front from well
V = Qt = cumulative volume of injected wastewater (in cubic ft.)
b = Injection zone thickness
φ = average porosity

7. Provide a report discussing the anticipated compatibility of the injection stream with both the interstitial fluids and formation minerals in the injection zone and the confining zone at expected temperature and pressures. The report should include anticipated reaction products. (**Common reactions are listed in Procedure #UICV-11, Procedure for Conducting A Compatibility Study for A Class V Injection Well which can be found at www. kdheks.gov/uic/download/.)** Reference the sources of this information.

8. Provide a plan for conducting a study of compatibility of the waste with the interstitial fluids and formation minerals in the injection zone and the confining zone. **(Procedure #UICI-11, Procedure for Conducting A Compatibility Study for Class Class V Wells can be found at www. kdheks.gov/uic/download/.**) Include the name of the laboratory that will be used for any core sample analysis and formation fluid testing.

9. Provide a report on the results of a corrosion test on all injection well components and appurtenances which will be in contact with the injection fluid. Include the name of the manufacturer of the components. All materials must be compatible with the injection fluid which the materials may be expected to come into contact. The materials shall be deemed to have compatibility as long as the materials meet or exceed standards developed for such materials by the American Petroleum Institute, the American Society for Testing Materials or comparable standards. Include a description of the methodology and procedures used to conduct the test and to make the compatibility determination. Include the manufacturer's test date for the injection tubing.

10. Injection Zone:

Formation(s) Name	Estimated Depth of Top*	Estimated Depth of Base*

Injection Interval:

Perf/Openhole _____ to _____, _____ to _____, _____ to _____ *

*Provide reference point for these values.

11. Top hole elevation _____ (Top hole elevation of the proposed disposal well, with a closed traverse from U.S.G.S. or approved bench mark tied to the U.S.G.S. bench mark system.)

12. Well Completion: Provide borehole, casing, tubing, packer and cement information. The tubing and packer for new wells shall be new. Surface casing and longstring casing for new wells shall be new and cemented bottom to top by circulating. Sufficient cement shall be used to circulate to surface plus a minimum of 20% excess. The well shall be cased and cemented such that: 1) injection fluids and injection zone or other formation fluids do not cause deterioration of the water quality of fresh and/or usable water zones, 2) the loss of fresh and/or usable water due to downward migration is prevented, and 3) the release of injection fluids into an unauthorized zone is prevented.

Borehole size	Casing/ Tubing size	Material	Weight lbs/ft	Casing seat depth	Joint lengths	Type Cement	Amount cement (sacks)	Cement interval from	to

Packer Grade and Type _____ Estimated Packer Setting Depth _____*

*Provide reference point for these values.

13. Describe the maximum burst pressure, collapse pressure and tensile stress which may be experienced including calculations, methodology and reference used to determine these. Provide the calculations, formulas, equations and methodology used to determine the casing, cementing, tubing, and packer are designed to tolerate the pressures or forces anticipated to the encountered or exerted on the well during construction, completion and operation. Include design factors used and provide references. **If there is the potential for significant variance in the temperature of the injection fluid, provide information demonstrating this has been accounted for in the injection tubing and packer design.** The casing burst pressure, casing collapse pressure and the casing tension shall be calculated using performance properties listed in American Petroleum Institute (API) Bulletin 5C2. Well casing shall meet the specifications set out in API Specification 5CT. Submit service company recommendations along with studies to determine the suitability of the selected cements. Describe the type, grade, additives, slurry weight and expected compressive strength of the cement. Describe the cementing techniques and equipment including guide shoe, float collar, plugs, baskets D V tools and their location. Describe the number and location of the centralizers, wall scratchers, etc. Describe in detail the procedures to be used to ensure satisfactory cementing of the various casings and the remedial action to be taken if primary cementing results are not satisfactory.

14. Annulus Monitoring System: The annulus between _____ and _____ (pipe size) is to be monitored for leaks. Type of liquid in annulus _____. Proposed minimum annulus pressure is _____ psig. **(The minimum approvable annulus pressure is 60 psig.)** Provide an MSDS for any additives in the annulus liquid. **Provide design plans for the annulus seal pot monitoring system. (An acceptable design example is attached.)**

15. Fluid Injection Rate:

    Injection fluid is to be injected at a minimum rate of _____ gallons/day to a maximum rate of _____ gallons/day. Provide a demonstration that the maximum injection rate is feasible.

16. Injection Pressure:

    Injection will be by means of gravity pressure (no pump pressure allowed) or _____ inches vacuum.

17. Discuss the proposed injection procedure for the well. Submit a flow diagram.

18. Surface Facilities:

    Describe and provide design information and diagrams for all surface retention facilities, holding tanks, lines, transfer pumps an filters associated with the injection operation.

19. Spill Prevention:

Provide a detailed spill prevention and containment plan for the injection operation. Provide design plans for any spill containment structure(s).

20. Environmental Remedial Action:

Should fresh or usable water or the soils become contaminated by a failure of the injection facilities, the permittee is responsible for investigating the contamination and any required remediation of the contamination. The permittee will be required to sign an agreement with KDHE which will establish guidelines and objectives for investigation and remediation of the contamination. Provide acknowledgement of this requirement.

21. Discuss how monitoring requirements for the injection operation will be met. Electronic continuous recording devices and gauge or meters are required to monitor tubing pressure, flow rate, volume and annulus pressure. Describe the meters or gauges and continuous recording devices that will be used to measure and record injection volume, injection rate, annulus pressure and tubing vacuum.

22. Provide a diagram indicating the location of all monitoring devices. Provide a quality assurance/quality control plan for obtaining reliable monitoring data. This includes method of calibration and frequency of calibration of gauges, meters and continuous recording devices. Include an injection fluid analysis plan that describes the procedures and methods to be used to obtain representative samples of the injection fluid to meet monitoring requirements.

23. Describe where the injection fluid samples will be collected for monitoring purposes, the method used to collect the samples, sampling containers, sample storage, chain of custody procedures and the quality assurance/control procedures used. All analyses required by the UIC permit shall be conducted by a laboratory certified by the State of Kansas.

24. Provide a certificate of means of financial assurance the well will be properly plugged and abandoned at the end of its useful life or when required by KDHE to protect the public health, fresh and/or useable waters or soils. This should include all injection wells owned by the applicant. **(Procedure #UICV-6, Procedure for Demonstrating Financial Assurance for a Class V Injection Well can be found at www.kdheks.gov/uic/download/.)**

25. Provide a plugging and abandonment plan for the well. Include a diagram. Describe the type, grade, quality and estimated quantity of cement to be used in plugging. Describe the method of cement placement. Provide three cost estimates for plugging the well. **(Procedure #UICV-8, Procedure for the Plugging and Abandonment of a Class V Injection Well can be found at www.kdheks.gov/uic/download/.)**

26. Provide a detailed plan for the testing program to determine the injection zone properties such as static fluid level, fluid pressure, and temperature.

27. Provide a schematic indicating the proposed well completion at the surface and subsurface.

28. Discuss the proposed injection interval stimulation program including fracture methods and chemical treatments.

29. Provide a plan for conducting the temperature log or oxygen activation log which is required to check for the absence of significant fluid movement behind the longstring casing. **(Procedure #UICV-7, Procedure for Conducting the Temperature Log for Evaluating External Mechanical Integrity of a Class V Injection Well can be found at www.kdheks.gov/uic/download/. In addition, Procedure #UICV-5, Procedure for Conducting the Oxygen Activation (OA) Log Procedure for Evaluating External Mechanical Integrity of a Class V Injection Well can be found at www.kdheks.gov/uic/download/.)**

30. Provide a plan for pressure testing the tubing/casing annulus for mechanical integrity. **(Procedure #UICV-4, Procedure for the Pressure Mechanical Integrity Test for Evaluating Internal Mechanical Integrity of a Class V Injection Well can be found at www.kdheks.gov/uic/download/.)**

31. Discuss how drilling fluids and the formation cuttings will be contained and managed to prevent fresh water or soil contamination. Describe the dimensions of the drilling tank and the reserve tank. Provide a plan describing how the liquid and solid contents of the drilling tank will be disposed. Provide a plan describing how the fluids and formation cuttings in the reserve tank will be disposed.

32. Provide a drilling prognosis for the well. This should include at a minimum the settings of casing, cementing, logging, coring and testing.

33. Describe the rock coring program. Include a representative well log with proposed core intervals indicated. At the minimum a core of a representative shale in the confining zone and a core of the injection zone must be obtained.

34. Describe the core testing procedures. The cores shall be analyzed for permeability, porosity and density and the lithology shall be described.

In addition, the permit will not become fully effective until the following have been received and approved by KDHE.

A. A complete set of logs of the well. New wells should have a minimum of the following logs or similar type logs. An interpretation of the logs by a person with the technical expertise to interpret the logs shall also be submitted.

Surface Bore Hole:

1. Caliper
2. Resistivity
3. Spontaneous Potential

Surface Casing:

4. Cement Bond and Variable Density

Longstring Bore Hole (including borehole below longstring casing):

5. Resistivity
6. Spontaneous Potential
7. Directional or Inclination Survey
8. Caliper
9. Gamma Ray-Neutron-Compensated Density
10. Fracture Finder

Longstring Casing:

11. Cement Bond
12. Caliper and Electromagnetic Casing Inspection

B. Complete casing and cementing information. Including cementing tickets, pipe tallies, work reports, and a drilling and completion history.

C. A chemical analysis of the injection interval fluid. Include partial chemical, heavy metals, VOC, temperature and pH analyses. All analyses shall be conducted by a laboratory certified by the State of Kansas.

D. A discussion of the injection interval characteristics. Include fluid pressure and temperature and describe the lithology of the injection zone. A core of the injection interval must be taken and the permeability, porosity and density determined and the lithology described.

E. A static fluid level measurement of the injection interval.

F. A description of the characteristics of the confining zone. A core of the confining zone must be taken and the permeability, porosity and density determined and the lithology described.

G. Supply a schematic drawing showing the actual well completion at the surface and subsurface.

H. Results and interpretation of a test of compatibility between the fluids to be injected and the injection interval fluids and matrix minerals at the determined temperature and pressure.

I. Revised calculations of predicted reservoir pressure build-up at a 0.25 mile radius from the injection well based on actual injection zone properties determined from the formation testing program. Include calculations, equations and parameters. This should be calculated for the expected life of the well.

J. Revised calculations of the cone of influence based on actual injection zone properties determined from the formation testing program. Include calculations equations and parameters. This should be calculated for the expected life of the well.

K. Revised calculation of distance of injection fluid flow from the injection well based on actual injection zone properties obtained from formation testing program.

L. Results of annulus pressure test and the test to check for fluid migration behind the casing. Results shall be submitted in the format described in Departmental guidelines.

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direct or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information. K.A.R. 28-46-22 requires this certification and this application be signed by a responsible corporate office, such as a President, Secretary, Treasurer or Vice-President of the corporation or other authorized signatory as described at the Code of Federal Regulations 40 CFR 144.32.

_____

Printed Name of Authorized Signatory

_____

Signature of Authorized Signatory Company Title

Effective 3/29/2011

This application shall be stamped and signed by a Kansas Licensed Geologist or a Kansas Licensed Engineer.

ATTACHMENT "A"
COMPOUNDS REQUIRING ANALYSIS
FOR CLASS V INJECTION WELLS

1. VOLATILE ORGANIC COMPOUNDS (Method 624-Purge & Trap GC/MS) Detection limits nominally 10 ug/L for Acrolein and Acrylonitrile at 100 ug/L.

Acrolein
Acrylonitrile
Benzene
Bromomethane
Bromodichlroromethane
Bromoform
Carbon Tetrachloride
(Tetrachloromethane)
Chlorobenzene
Chloroethane
2-Chloroethylvinly ether
Chloroform
Chloromethane (Methylchloride)
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethane
1,2-Dichloropropane
Cis-1,3-Dichloropropane
trans-1,3-Dichloropropane
Ethylbenzene
Methylene chloride
(dichloroemethane)
1,1,2,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethane
Trichlorofluoromethane
Toluene
Vinyl Chloride

2. ACID ORGANIC COMPOUNDS (Method 625-Extractions GC-MS) Detection limits nominally 25 ug/L except for dinitro compounds at 250 ug/L

4-Chloro-3-methylphenol
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2-Methyl-4,6-dinitrophenol
2-Nitrophenol
4-Nitrophenol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

3. BASE/NEUTRAL ORGANIC COMPOUNDS (Method 625-Extraction GC/MS) Detection limits nominally 10 ug/L

A. Polynuclear Aromatics
Acenaphthene
Acenaphthylene
Anthracene
Benzo (a) anthracene
Benzo (b) fluoranthene
Benzo (a) fluoranthene
Benzo (a) pyrene
Benzo (g,h,i) perylene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthane
Fluorene
Indeno (1,2,3-cd) pyrene
Naphthalene
Phenanthrene
Pyrene

B. Ethers & Esters
Bis (2-chloroethyl) ether
Bis (2-chloroethoxy) methane
Bis (2-ethylhexyl) phthalate
Bis (2-chloroisopropyl) ether
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
4-Chlorophenyl phenyl ether
Diethylphthalate
Dimethylphthalate
Dioctylphthalate
Di-n-butylphthalate
Isophorone

C. Nitrogen Containing Compounds
Benzidine
2,4-Dineitrotoluene
2,6-Dinitrothlune
1,2-Diphenylhydrazine Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-proplamine
N-Nitrosodiphenylamine

D. Chlorinated Hydrocarbons
2-Chloronaphthalene
1,3-Dichloronbenzene
1,4-Dichloronbenzene
3,3-Dichloronbenzidine
Hexachlorobenzene
Hexachlorobenzidine
Hexachloroethane
Hexachlorocyclopentadiene
2,3,7,8-Tetrachlorodibenzo-p-dioxin
1,2,4-Trichlorobenzene

4. PESTICIDE COMPOUNDS (Method 625-Extraction GC/EC) Detection limits nominally 0.01 ug/L

Aldrin
α-BHC
β-BHC
δ-BHC
γ-BHC
Chlorodane
4,4'-DDD
4,4'DDD
4,4'DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Heptachlor Expoxide
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

5. HEAVY METALS

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

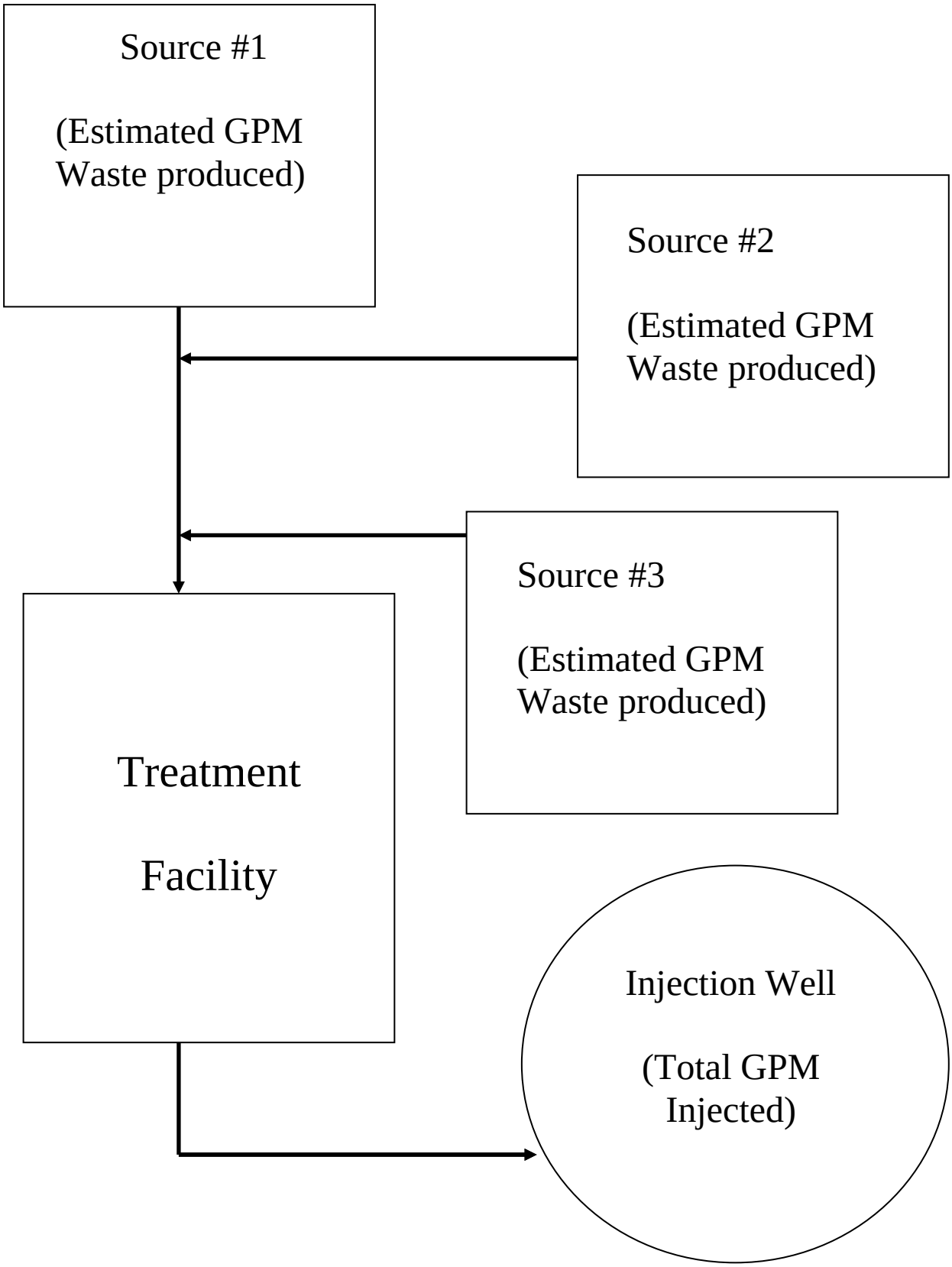
6. MICELLANEOUS

Cyanides
Phenols

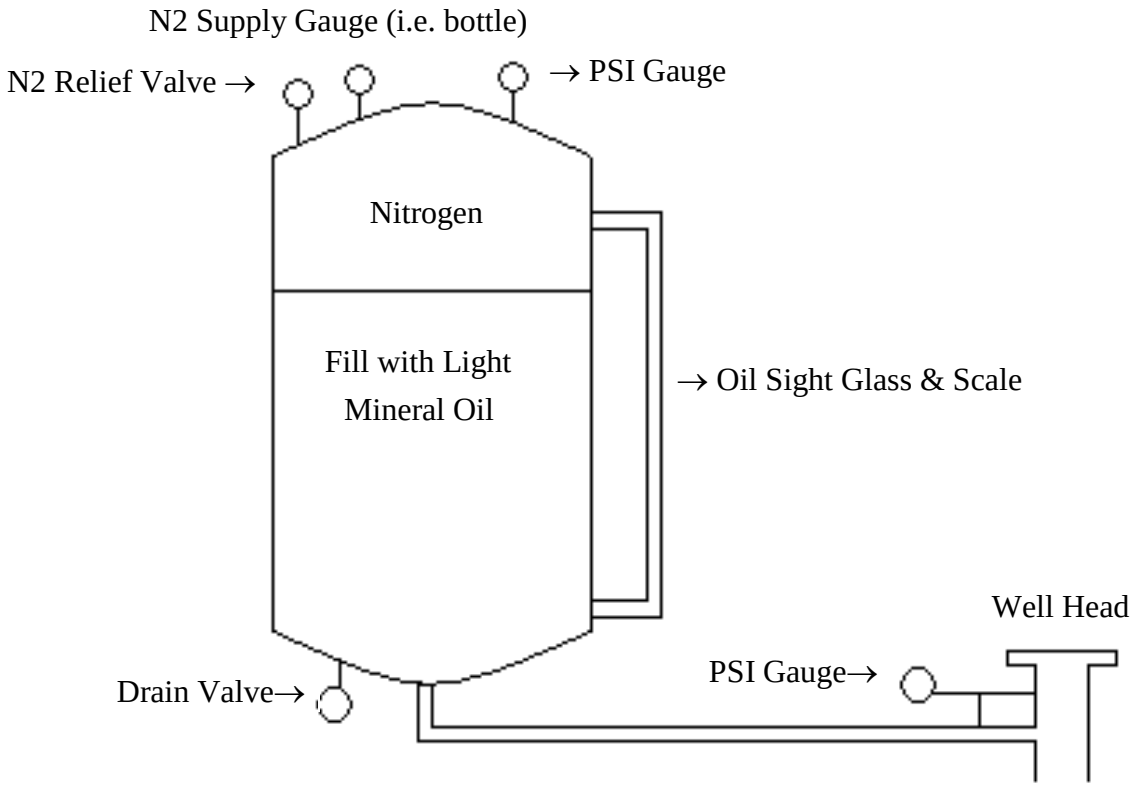
7. GEOCHEMICALS

Total Hardness ($CaCO_3$)
Calcium
Sodium
Magnesium
Potassium
Total Alkalinity
Chloride
Sulfate
Fluoride
Nitrate
Iron
Manganese
Ammonia
Phosphate
Silica
Specific Conductance
Total Dissolved Solids
Total Suspended Solids
Oil and Grease

TYPICAL BLOCK DIAGRAM



TYPICAL ANNULUS SEAL POT



db
R/geology/Procedures/Class V Injection Well Application 2011
3-29-2011