GeoNote 17

AGRICULTURAL INJECTION WELLS IN IDAHO

Agricultural injection wells, also known as drain wells, are principally used to dispose of runoff from gravity irrigation. They are drilled and constructed in much the same way as production wells. Their function, however, is to eliminate water by moving it into subsurface geological formations rather than to draw it from the subsurface.

Typically, excess irrigation water obtained from surface diversions or pumped from the ground is collected at the base of a gravity-irrigated field and routed through ditches to the injection well opening. It is forced, or injected, into geological formations by the weight of the column of water in the well bore. This water may be forced into the dry pore spaces of rocks or sediments above the water table, where it percolates downward and mixes with moving ground water. It may also be injected beneath the water table, where it mixes with ground water.

The use of injection wells for irrigation drainage has played a major role in the agricultural development of the Snake River Plain of southern Idaho. Large areas that would have been unsuitable for irrigation were put into production because injection wells readily solved the problem of draining the closed basins in some areas of the plain. In fact, with over 400 active drain wells, Idaho has the most documented agricultural injection wells in the U.S.

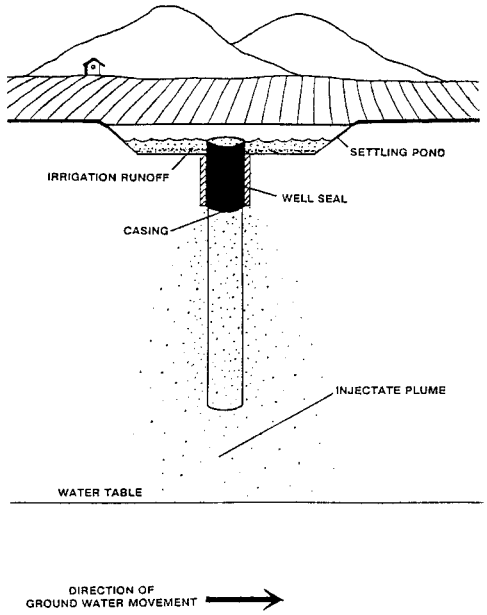
Concerns for Ground-Water Contamination

Injection wells are an efficient mechanism for eliminating runoff from gravity-irrigated fields. Yet, the waste water they inject may contain contaminants that could adversely impact the quality of ground water.

The quality of injected waste water is highly variable, as are the geological conditions into which the water is moved. In the best case, waste water contains virtually no contaminants and is clean enough to drink. In the worst case, waste water contains high levels of suspended sediment, intestinal bacteria, and trace quantities of agricultural chemicals, such as pesticides and fertilizers.

When contaminated waste water is injected above the water table, various biological, mechanical, and chemical processes can purify the fluid before it reaches the ground water. When water is injected directly into the aquifer, fewer purification mechanisms may be available. The extent to which contaminants may affect the quality of ground water depends on characteristics of the waste water, the geological and biological environment through which it passes, and the ground-water body itself.

Although uncommon, local cases of domestic well contamination directly attributable to injection well use have been documented in Idaho. In general, domestic



Schematic drawing of an agricultural injection well. Runoff from gravity-irrigated fields is routed through ditches to a settling pond where the fluid overflows the top of the well casing and is thereby injected into subsurface geological formations. The plume of injected fluid eventually percolates downward to the water table, where it mixes with moving ground water.

(over)

IDAHO GEOLOGICAL SURVEY

MAIN OFFICE AT MOSCOW
MORRILL HALL, THIRD FLOOR
UNIVERSITY OF IDAHO
PO BOX 443014
MOSCOW, ID 83844-3014

BRANCH OFFICE AT BOISE
MATH-GEOLOGY, ROOM 223C
BOISE STATE UNIVERSITY
BOISE, ID 83725-1535

BRANCH OFFICE AT POCATELLO
PHYSICAL SCIENCE, ROOM 235
IDAHO STATE UNIVERSITY
CAMPUS BOX 8072
POCATELLO, ID 83209-8072

www.idahogeology.org 208-885-7991 email: igs@uidaho.edu
SINCE 1919, SERVING THE STATE THROUGH GEOLOGIC RESEARCH

wells may be impacted when (1) contaminants are present in high concentrations in the injected fluids; (2) the removal of contaminants by mechanical, biological, or chemical processes is insufficient or lacking; or (3) the dilution of injected fluids by ground water is insufficient to prevent the contamination of a nearby well.

Unfortunately, it is rarely possible to tell what conditions prevail in the subsurface that may invite a problem. However, limiting the concentration and types of pollutants in injected fluids is a sure way to minimize the chance of contamination to ground-water users.

The temporarily abandoned well also has its risk. As more Idaho farmers replace gravity irrigation systems with sprinklers, injection wells are often retained in the event a return to gravity irrigation ever is necessary. Sometimes, however, a well is forgotten, and its location becomes overgrown or obscured by vegetation. The hidden well bore with protruding casing presents a hazard to pedestrians, farm animals and equipment, and curious children. An unmaintained injection well may also become a convenient illegal disposal site for toxic substances, which may in turn harm ground water.

Preventive Measures

Several methods are available to limit or prevent the possibility of ground-water contamination by injection fluids. The most common pollutant in runoff is intestinal bacteria from livestock. This contamination can be avoided simply by removing animals from the vicinity of the well opening or by discontinuing or restricting the use of manure fertilizer.

Allowing greater time between gravity irrigation and the application of agricultural chemicals can also prevent ground-water contamination. Some of these substances degrade or are taken up faster at the surface than in the subsurface. Allowing more time between their application and subsequent irrigation reduces their concentrations in the injected water.

A pond around the well opening allows sediment and adhering agricultural chemicals to settle and degrade before entering the well. Enlarging the pond to provide a longer settling time usually improves the quality of the water being injected. Routing runoff through a grassy strip or swale also promotes the biological uptake of contaminants, and it has the added benefit of limiting soil erosion.

Alternatives to Injection Wells

In addition to techniques for reducing contaminants in injected water, other methods eliminate the need for injection wells entirely. Irrigation runoff may be collected in ponds for storage or pumped back and reused on other lands. Injection wells can also be replaced by sand and gravel seepage pits. Runoff collected in these pits both evaporates and percolates into the ground. While some persistent contaminants may still reach the ground water, nonpersistent contaminants such as bacteria and most pesticides will degrade at the surface.

The principal alternative to injection wells is sprinkler irrigation systems. Sprinklers use water more efficiently and do not ordinarily create standing ponds. Sprinklers also conserve valuable topsoil, which gravity irrigation removes and carries into collection ditches and down injection wells.

The construction of new injection wells for irrigation drainage in Idaho peaked in the 1950s and has steadily declined since. Many Idaho farmers have recognized the economic benefits of sprinkler irrigation in enhanced crop yield, lower labor costs, less erosion, and more efficient use of water. About half of southern Idaho is now sprinkler irrigated. As more land is placed under sprinklers, fewer injection wells will be needed for the disposal of irrigation runoff.

As sprinkler usage increases, so will injection well abandonments. Some unused wells are properly and permanently abandoned; these have been filled with impermeable clay or grout and have had their casings cut off below the ground surface. Temporarily abandoned wells should be properly maintained to prevent accidents or misuse. Wherever possible, unused injection wells should be permanently plugged and abandoned.

Prepared by John D. McLeod, hydrogeologist
Idaho Department of Water Resources
1191