

Water Well Decommissioning Guidelines



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Approved By: Gerard MacLellan

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I. Introduction

The *Water Well Decommissioning Guidelines* provide instructions for completing water well decommissioning that is protective of groundwater and conducted in a manner acceptable to Nova Scotia Environment and Labour (NSEL). Water wells that NSEL specifically requires to be decommissioned, or other water wells that are not used or maintained for present or future use, must be immediately decommissioned following these Guidelines, according to the *Well Construction Regulations*.

The *Water Well Decommissioning Guidelines* are not intended to apply to environmental wells installed for groundwater contaminant monitoring or remediation purposes, for which other more applicable decommissioning methods may be required.

The objectives of water well decommissioning are to prevent surface water infiltration into an aquifer via the well, prevent the vertical movement of water within a well and remove physical hazards.

II. Definitions

In these guidelines, the following definitions apply:

bentonite	a type of processed natural clay material used to seal wells. When hydrated with water, bentonite has low permeability, is non-shrinking and is highly viscous. Bentonite is available in powder (for slurries), granular, chip and pelletized form.
clay	an extremely fine grained, cohesive soil material that meets the classification for clays as determined under ASTM Standard ASTM D2487, <i>Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)</i> and has a relatively low permeability capable of meeting a laboratory-tested value for hydraulic conductivity of no greater than 10^{-6} cm/s.
decommission	means to permanently fill in and seal a well to eliminate the well as a source of water, or as a potential physical hazard and to prevent movement of water within the well.
drilled well	a well that is constructed by drilling a hole in the aquifer using a drill, such as a rotary drill, cable tool or jet drill;
dug well	a well that is constructed by digging a hole into the aquifer either manually or mechanically;
grout	a stable and impervious bonding material that is capable of preventing the vertical movement of water: along the outside of a casing; between well casings and well liners; and in decommissioned wells. Typical grout materials include bentonite and neat cement. In some cases, such as for salt water or contaminated well applications, grout may need to be specifically designed to be non-shrinking and non-reactive.

high solids bentonite grout	a type of grout consisting of a mixture of powdered or granular, bentonite clays and water, that contains at least 20 percent bentonite solids by weight and when set exhibits a flexible, low permeability grout seal.
neat cement	cement slurry containing Portland cement and water. When cured, neat cement forms a hard, rock-like impermeable barrier.
NSEL	Nova Scotia Environment and Labour.
pressure grout method	method of grout placement that pumps liquid grout under pressure through a hollow tremie pipe, or hose, placed to the bottom of a well. The tremie pipe is typically gradually withdrawn as grouting proceeds to fill the well. Water is displaced as the grout fills the hole from the bottom up to the surface.
well	an artificial opening in the ground made for the purpose of obtaining groundwater supply and includes the well casing and any attached parts, but does not include constructed ponds or dugouts.

III. Typical Decommissioning Methods

Drilled well decommissioning must be conducted only by well drillers holding a valid certificate of qualification (certified well driller), dug well decommissioning only by well diggers holding a valid certificate of qualification (certified well digger), or either type of well may be decommissioned by an individual conducting work on lands that they own or lease. Certification requirements are contained in the *Well Construction Regulations*. These guidelines must be followed for all well decommissioning.

The following are typical decommissioning methods required by NSEL for drilled wells and dug wells. If these methods are followed no prior application or notice to NSEL is required, as noted in the *Well Construction Regulations*. However, decommissioning of water wells under conditions other than the typical ones described does require prior submission to, review of, and acceptance by NSEL.

A. Drilled Wells

- 1) Remove all pumping equipment including pumps and other obstructions from the well.
- 2) Measure and record the static water level depth, total depth of the well, depth of well casing and diameter of well casing.
- 3) Calculate and record the theoretical volume of grout materials needed to fill the well.
- 4) Remove entire casing if feasible, otherwise where the bedrock-soil interface allows cut casing at least 0.6 m below grade surface, or cut casing at the bedrock surface. [Note: Where removal of casing may result in geologic formation collapse into the borehole, this should be accounted for in the decommissioning design.]

5) Well grout materials for typical decommissioning must be installed by either:

- a) **pressure grout method** - Place an appropriate mix of neat cement, sand-cement concrete mix (no gravel), high solids bentonite grout or other non-shrinking liquid grout from the bottom of the well to the top of casing using a tremie pipe or hose.

Volumes of liquid grout placed in a well should closely match the estimated amount needed to fill the well. Where possible, place at least 0.3 m additional grout above the top of the casing, followed by a minimum of 0.3 m compacted natural fill to be level to grade surface; or

- b) **hand placement of dry granular bentonite chips** - For wells less than 61 m (200 ft) deep, medium or coarse grade, dry screened bentonite chips may be installed by hand pouring. For wells greater than 61 m (200 ft) deep it is recommended that only coarse grade (i.e. 3/4 inch or greater) dry screened bentonite chips be used for hand placement.

All dry granular bentonite chips used must be adequately screened over a wire mesh screen during placement to prevent fine particles that are typically present in bags from entering the well and causing premature swelling and bridging. Bentonite chips must be poured slowly into a well no faster than manufacturer recommended rates. Bentonite grout levels must be checked periodically using a weighted line to ensure bridging is not occurring in the well.

Volumes of bentonite chips placed in a well should closely match the estimated amount needed for sealing. Fill to the top of the casing. Where possible, place at least 0.3 m additional grout above the top of the casing, followed by a minimum of 0.3 m compacted natural fill to be level to grade surface.

- 6) Complete at surface by ensuring mounding, paving or grading to eliminate surface water ponding, as well as using topsoils to promote the establishment of vegetation, if appropriate. The potential for grout settlement should be considered and accounted for.
- 7) Complete a *Water Well Decommissioning Record* with the information required under the *Well Construction Regulations* and submit to NSEL.
- 8) Other drilled well grouting methods may be possible. However, site specific decommissioning methods that do not follow the typical methods described in Section III A for drilled wells, must follow Section III C.

B. Dug Wells

- 1) Remove all pumping equipment including pumps and other obstructions from the well.

- 2) Measure and record the static water level depth, total depth of the well, depth of well casing and diameter of well casing.
- 3) Calculate and record the theoretical volume of grout and other materials needed to fill the well.
- 4) Pump down water level in the well as much as is practicable.
- 5) Remove cement crocks or other well casing materials from surface to at least 1.5 m below grade surface, however it is not necessary to remove casing materials below the static water level depth. [Note: Where removal of casing may result in geologic formation collapse into the borehole, this should be accounted for in the decommissioning design.]
- 6) If the base of the dug well is in contact with bedrock, install a layer of commercial bentonite grout from the base of the well to at least 0.3 m above the bedrock/overburden interface, prior to following backfilling requirements of 7).
- 7) Install backfill of clean natural soils (free of large roots, vegetation or other organic matter, or boulders) in compacted layers no greater than 3 m thick, from the base of well to 1 m below grade surface.
- 8) The upper 1 m of backfill material must include either:
 - a) 1 m of uniform, clean, compacted clay free of boulders; or
 - b) a layer of at least 0.3 m of dry granular bentonite.
- 9) Complete at surface by ensuring mounding, paving or grading to eliminate surface water ponding, as well as using topsoils to promote the establishment of vegetation, if appropriate. The potential for grout settlement should be considered and accounted for.
- 10) Complete a *Water Well Decommissioning Record* according to the *Well Construction Regulations* and submit to NSEL
- 11) Other dug well backfilling methods may be possible. However, site specific decommissioning methods that do not follow the typical methods described in Section III B for dug wells must follow Section III C.

C. Site Specific Decommissioning Methods for Special Conditions

Some water wells have special conditions for which typical decommissioning methods in some cases may not be recommended by certified well drillers/diggers. Such wells could include, among others, those groundwater supply wells that:

- a) have flowing artesian conditions;
- b) have salt water impacts;
- c) are high yield production wells;

- d) are extremely deep;
- e) are contaminated by natural or man-made conditions;
- f) are constructed by neither drilling nor digging; or
- g) have other unusual conditions.

These water wells may require alternative site specific decommissioning methods or specialized grout materials. For such wells, if decommissioning methods are to deviate from Section III A or Section III B of these Guidelines, alternative methods must be proposed in a written decommissioning plan to NSEL by a certified well driller/digger or a registered, professional geoscientist (P.Geo.) or engineer (P.Eng.) qualified in hydrogeology. The decommissioning plan must be acceptable to NSEL. Decommissioning must not proceed until written acceptance of the plan from NSEL is received by the proponent.

Environmental wells installed for groundwater contaminant monitoring or remediation purposes should follow other NSEL decommissioning guidance.

IV. Required Documentation

Each certificate holder or individual who is responsible for completing the decommissioning of a water well must:

- (a) deliver a copy of the record to the owner after the water well decommissioning is completed;
- (b) deliver the record to NSEL after the water well decommissioning is completed
 - (i) immediately upon request by NSEL; or
 - (ii) by January 31 of the calendar year following the water well decommissioning.
- (c) keep a copy of the record for at least 2 years after the date the water well decommissioning is completed.

June 1, 2007

Dated _____

Original Signed By: _____

Gerard MacLellan

Executive Director

Environmental Monitoring and Compliance

Nova Scotia Environment and Labour