# Well Decommissioning Guidelines

**VERSION 1.3: December 2023**

# About the Regulator

The BC Energy Regulator (Regulator) is the single-window regulatory agency with responsibilities for regulating oil and gas activities in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Regulator's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected by ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

## Vision, Mission and Values

### Vision

A resilient energy future where B.C.'s energy resource activities are safe, environmentally leading and socially responsible.

### Mission

We regulate the life cycle of energy resource activities in B.C., from site planning to restoration, ensuring activities are undertaken in a manner that:

- Protects public safety and the environment
- Supports reconciliation with Indigenous peoples and the transition to low-carbon energy
- Conserves energy resources
- Fosters a sound economy and social well-being


### Values

Respect is our commitment to listen, accept and value diverse perspectives.

Integrity is our commitment to the principles of fairness, trust and accountability.

Transparency is our commitment to be open and provide clear information on decisions, operations and actions.

Innovation is our commitment to learn, adapt, act and grow.

Responsiveness is our commitment to listening and timely and meaningful action.

# Additional Guidance

As with all Regulator documents, this document does not take the place of applicable legislation. Readers are encouraged to become familiar with the acts and regulations and seek direction from Regulator staff for clarification.

The Regulator publishes both application and operations manuals and guides. The application manual provides guidance to applicants in preparing and applying for permits and the regulatory requirements in the planning and application stages. The operation manual details the reporting, compliance and regulatory obligations of the permit holder. Regulator manuals focus on requirements and processes associated with the Regulator's legislative authorities. Some activities may require additional requirements and approvals from other regulators or create obligations under other statutes. It is the applicant and permit holder's responsibility to know and uphold all legal obligations and responsibilities. For example, Federal Fisheries Act, Transportation Act, Highway Act, Workers Compensation Act and Wildlife Act.

Throughout the document there are references to guides, forms, tables and definitions to assist in creating and submitting all required information. Additional resources include:

- Glossary and acronym listing on the Regulator website.
- Documentation and guidelines on the Regulator website.
- Frequently asked questions on the Regulator website.
- Advisories, bulletins, reports and directives on the Regulator website.
- Regulations and Acts listed on the Regulator website.

In addition, this document may reference some application types and forms to be submitted outside of the Application Management System but made available on the Regulator's website. Application types and forms include:

- Heritage Conservation Act, Section 12
- Road use permits
- Water licences
- Master licence to cut
- Certificate of restoration
- Waste discharge permit
- Experimental scheme application
- Permit extension application

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# Manual Revisions

The Regulator is committed to the continuous improvement of its documentation. Revisions to the documentation are highlighted in this section and are posted to the Documentation Section of the Regulator's website. Stakeholders are invited to provide input or feedback on Regulator documentation to ServiceDesk@bc-er.ca or submit feedback using the feedback form.

| Version Number | Posted Date | Effective Date | Chapter Section | Summary of Revision(s) |
|---|---|---|---|---|
| 1.0 | November 2021 | January 2022 | - | Initial publication. |
| 1.1 | April 1, 2022 | April 1, 2022 | 1.2 | Professional practice compliance awareness. |
| 1.2 | November 16, 2022 | November 18, 2022 | 1.3 | Removed the submission requirements that are no longer needed as part of the new Notice of Abandonment and Abandonment Report eSubmission portal. |
| 1.3 | Dec. 6, 2023 | Dec. 06, 2023 | Various | Replace BCOGC with BCER; OGAA with ERAA; new logos, references and associations |

# Chapter 1: Introduction

## 1.1 Purpose

This document provides guidance to permit holders regarding well decommissioning practices, including zonal abandonment, surface casing vent flow (SCVF) or gas migration (GM) repairs, groundwater protection and surface decommissioning. Permit holders are expected to meet or exceed these guidelines in order to comply with the requirements of section 26 of the Drilling and Production Regulation (DPR), which include the isolation of porous intervals, ensuring fluids do not leak from the wellbore and ensuring the long term integrity of the well.

## 1.2 Compliance

All submissions made to the Regulator in support of an application or a regulatory requirement that include work relating to the practice of professional engineering or professional geoscience are expected to accord with the Professional Governance Act, [SBC 2018], c. 47 and the Bylaws of Engineers and Geoscientists British Columbia (EGBC). This includes any requirements relating to authentication of documents.

## 1.3 Notification and Reporting

Under section 26 (1) (a) of the DPR, a permit holder must submit a plugging program to the Regulator at least 7 calendar days before commencement of operations. This notification is to be submitted electronically through eSubmission and include a wellbore diagram and a complete program of activities to be undertaken. Permit holders may submit NOOs before the regulatory minimum 7 days to allow for modifications to be made, if necessary.

Under section 26 (1) (c) of the DPR, a permit holder must submit an abandonment report to the Regulator within 30 days of the completion of activities. This report must include a completed copy of the Completion/Workover Report Form, a complete record of the daily reports including all significant operations undertaken, a downhole schematic illustrating the configuration of the well at the end of the operation and any other information respecting the work conducted. If the abandonment report includes surface decommissioning, a photograph of the cut & capped casing stub including identifying information welded thereon must be included in the Completion/Workover Report. The Report is submitted electronically through eSubmission and is reconciled against a previously-submitted NOO.

If a well is decommissioned prior to the release of the drilling rig, no advance notification is required, though permit holders are encouraged to consult with the Regulator's Drilling and Production staff prior to completing downhole abandonment operations. If surface decommissioning, including the final cut and cap, is not completed and reported

on the Summary Report of Drilling Operations (SRDO), the well is not considered to be decommissioned. In those cases, surface decommissioning activities must be reported separately as though the well were cased.

## 1.4 Routine vs Non-Routine

"Routine" and "non-routine" are used to describe zonal abandonment or wellbore remediation operations that form part of a well decommissioning program. Operations are routine if the proposed method is one that is described in this guideline. Operations are non-routine if the proposed method is identified in this guideline as being non-routine, or if the proposed method differs from one described in this guideline. When planning to complete a zonal abandonment or remedial operation in a well, a permit holder must determine whether a given operation is routine or non-routine prior to submitting an NOO.

### Please Note:

Permit holders will be expected to demonstrate that a proposed non-routine zonal abandonment method will meet or exceed the results that would be obtained by conducting a routine zonal abandonment. Permit holders are encouraged to contact the Regulator's Drilling & Production staff (individually, or via drilling.production@bc-er.ca) prior to submitting a decommissioning program that includes one or more non-routine zonal abandonments.

Some examples of non-routine zonal abandonments include, but are not limited to:

- Abandonment plugs set higher than the specified maximum allowable distance above a completed interval;
- Abandonment plugs set in such a manner that porous intervals (not in pressure communication with the completed interval) behind cemented casing are located between the plug and the completed interval being abandoned;
- Multiple completed intervals being abandoned beneath a single plug, whether previously approved for commingled production or not;
- The use of a zonal abandonment method shallower than the Base of Usable Groundwater (BUGW, as defined in INDB 2016-09) or the surface casing shoe, including for the remediation of shallow casing failures;
- The use of materials other than class "G" cement or resin-based low permeability cement;
- Re-abandonment due to a leaking zonal abandonment plug.

# Chapter 2: Previously Decommissioned Wells and Abandoned Zones

## 2.1 Previously Decommissioned Wells

Wells that were decommissioned to the standards in place prior to this edition of the Well Decommissioning Guidelines are not required to be brought up to current standards. The exceptions to this are for cases where an Abandoned Well Leak (AWL) develops, or where a wellbore is being re-entered for another purpose resulting in the removal of existing plugs.

## 2.2 Previously Abandoned Zones

Non-decommissioned wells with zonal abandonments that were compliant at the time of the abandonment operation are not required to be re-abandoned to current standards, except where either a Level A interval, as described in section 4.1, is involved, or where the existing abandonment plugs are leaking. Permit holders are encouraged to assess the condition of all abandonment plugs, especially those that were compliant in the past but are no longer.

### 2.2.1 Level A Intervals

Where a well has a completed Level A interval that has not been isolated by an acceptable method from this Guideline, an additional cement plug must be circulated in place. This plug must be as close to the top of the uppermost zonal abandonment plug as possible, must be a minimum length of 30 vertical metres and have a minimum volume of 1 $m^3$.

If the uppermost abandonment plug is located above the BUGW, it must be drilled out and the additional cement plug described above must be placed on the abandonment plug below. The rest of the well must then be isolated as described in the rest of this guideline.

### 2.2.2 Leaking Zonal Abandonment Plugs

Where an existing zonal abandonment has been found to be leaking, that zonal abandonment must be brought up to current standards. This may include removing the previous abandonment plug and replacing it, or using another zonal abandonment method altogether.

## 2.3 Abandoned Well Leaks

Permit holders must submit an AWL report in eSubmission if a decommissioned well is found to be leaking. This report must include all relevant information, including a brief summary of any investigation performed and the completion of all fields as described in the eSubmission User Guide.

### Please Note:

Submissions cannot be made against a well that has a Certificate of Restoration (COR). Permit holders must contact the Regulator's Drilling and Production staff for assistance prior to submitting an AWL report or NOO.

Following the submission of an AWL report, the permit holder must:

- Submit an NOO for any further investigatory and/or repair work required to repair the leak;
- Notify the mineral rights owners if not held by the permit holder, or the Ministry of Energy, Mines and Petroleum Resources (MEMPR) if they have reverted to the Crown;
- Have a surface access agreement prior to commencing operations on the well;
- Submit a SCVF or GM report via eSubmission, if the AWL is found to be a result of SCVF and/or GM;
- Repair the leak in accordance with the requirements of section 4.11 in this guideline and section 9.7 in the Oil and Gas Activities Operations Manual.

## 2.4 Well Re-entry

Wells that are decommissioned and later re-entered, for example for disposal evaluation, must be decommissioned in accordance with this guideline from the re-entry depth to surface. If there are abandoned zones below the re-entry depth, the requirements set out under section 2.2 apply.

# Chapter 3: Open-hole Abandonment Requirements

## 3.1 Overview

For the downhole abandonment of an open-hole well, the permit holder must set cement plugs of sufficient length and number to:

- Cover all usable groundwater intervals from surface to the BUGW, which may include the use of cemented surface casing, and
- Isolate or cover all porous intervals from BUGW to the total depth of the well.

Porous intervals are defined as:

- Carbonates with effective porosity greater than 1 per cent;
- Sandstones with effective porosity greater than 3 per cent;
- An interval with production, injection or disposal occurring in an adjoining spacing area, regardless of the porosity;
- An interval containing hydrocarbons capable of producing as an unconventional zone;
- Any zone with drillstem test formation liquid recoveries greater than 300 linear metres or gas volumes greater than 300 $m^3$.

## 3.2 Open-hole Abandonment Plug Placement

When conducting open-hole zonal abandonments, permit holders must ensure the following:

- Well logs, if available, are used to determine plug placement for zones deeper than the BUGW.
- All open hole cement plugs are circulated in place, using best practices to ensure plug stability.
- Plugs run at a depth less than 1500 metres TVD are a minimum length of 30 vertical metres and extended a minimum of 15 vertical metres above *and* below the zone being covered.
- Plugs run at a depth more than 1500 metres TVD are a minimum length of 60 vertical metres and extended a minimum of 30 vertical metres above *and* below the zone being covered.
- The uppermost plug that contacts an uncased portion of the wellbore must extend a minimum of 15 vertical metres above the casing shoe of the deepest casing set.

A plug may extend over more than one zone. Plugs may be run in stages, but the break between stages may only occur within a given zone, and be as far from a zone top as practical. There is no maximum distance between plugs, however the formation fracture pressure of any interval below a given open hole plug must not be exceeded by the in-situ pressure of any porous interval that is below that same plug.

In a well where intermediate casing has been set, but not cemented above the shoe of the previous casing string, the uncemented interval must be evaluated as follows:

- If the BUGW has not been covered by surface casing and the intermediate casing cement top is below the BUGW, remedial cementing must be conducted to cover usable groundwater.
- If there are porous intervals not covered by the intermediate casing cement, remedial cementing must be conducted to cover and/or isolate the interval.

Refer to Appendix A for an example of remedial cementing.

## 3.3 Verifying Open-hole Plug Placement

Permit holders must verify the location of all open-hole plugs using one of the methods described in section 5.1. The only exceptions to this requirement are if:

- A continuous cement plug is placed from total depth to surface, in one or more stages, provided there was no loss of circulation;
- The uppermost plug, in a well being abandoned with multiple plugs, is being circulate to surface;
- A single stage of a multistage plug is being placed, provided there is no loss of circulation.
    - The final stage of a multistage plug must always be verified, unless its top is located at surface

If the location of the plug cannot be verified, or if verification indicates the placement of the plug does not comply with the requirements laid out in section 3.2, the permit holder must correct the incorrectly placed plug and verify its location. This may require the plug be built up, drilled or circulated out, or other remedial action as appropriate.

# Chapter 4: Cased-hole Abandonment Requirements

## 4.1 Overview

For the downhole abandonment of a cased-hole well, the permit holder must:

- Ensure all usable groundwater is covered by cement, or where coverage cannot be achieved, isolated from below and above;
- Ensure isolation between all porous intervals behind casing,
- Establish isolation between all completed intervals,
- Determine whether any uncompleted intervals, particularly uncompleted Level A, high pressure, or hydrocarbon-bearing unconventional zones require isolation.

The plugging requirements for a cased-hole well will depend on whether:

- The well was completed;
- The well was completed in an interval that is classified as Level A, as defined below;
- The well was completed in an interval that meets the definition of a high pressure interval, as defined below;
- The well has a history of integrity issues, including casing failure, SCVF or GM.

### 4.1.1 Definition of Level A Intervals

For the purposes of the guideline, Level A intervals are those that:

- Have been used for disposal of Class 1a or 1b fluids, as described in Appendix B;
- Have been used for disposal of acid gas or storage of $CO_2$, including wells completed in a pool approved for acid gas disposal or $CO_2$ storage;
- Have a representative $H_2S$ concentration greater than or equal to 15 per cent; or
- Have ever met the criteria for designation as Special Sour, as defined in the Oil and Gas Activity Application Manual.

### 4.1.2 Definition of High Pressure Intervals

For the purposes of the guideline, high pressure intervals are those that:

- Have an original pressure gradient in excess of 14 kPa/m, measured from surface;
- Have been used for injection or disposal and where the pool pressure at time of abandonment exceeds the pool discovery pressure.

## 4.2 Cement Evaluation

Permit holders must assess the condition of cement behind casing prior to beginning downhole abandonment operations. Cement evaluation logs must be run unless there is sufficient evidence to demonstrate that primary cementing has resulted in adequate hydraulic isolation along the entire wellbore. Some factors to consider include, but are not limited to:

- The presence of SCVF or GM;
- Theoretical calculations of cement top, or absence of cement returns to surface;
- Partial or total loss of returns during cementing.

Permit holders are encouraged to refer DACC IRPs 25, 26 and 27 for additional information on evaluating cement.

## 4.3 Identification and Isolation of Porous Intervals

Permit holders must identify porous intervals encountered in the well and determine whether hydraulic isolation has been established between them. Porous intervals are defined as:

- Carbonates with effective porosity greater than 1 per cent;
- Sandstones with effective porosity greater than 3 per cent;
- An interval with production, injection or disposal occurring in an adjoining spacing area, regardless of the porosity;
- An interval containing hydrocarbons capable of producing as an unconventional zone;
- Any zone with drillstem test formation liquid recoveries greater than 300 linear metres or gas volumes greater than 300 $m^3$

Where it cannot be determined that hydraulic isolation has been established between porous intervals, remedial operations must take place.

## 4.4 Use and Placement of Bridge Plugs

For the purposes of completing a zonal abandonment of an interval that is not Level A, when a bridge plug is being used to support a column of cement, that plug must be:

- Set less than 15 vertical metres above the interval to be abandoned; or
- Set at a depth where all of the following are met:
    - The depth is within the same formation as the completed interval, or within the next formation provided there are no other porous intervals between the bridge plug and the completed interval
    - The cement top behind the casing extends above the top of the formation in which the bridge plug will be set

- The depth is below the BUGW.

The bridge plug must then be pressure tested as described in section 5.2, before being capped with the required amount of cement. If more than one year has elapsed between the setting and pressure testing of the bridge plug and the placement of cement, the plug must be pressure tested again prior to placing cement.

**Please Note:**

Numerous sections in this Chapter make reference to "bridge plug" as a means of achieving isolation prior to placing cement. For the purposes of serving as a platform to support a column of cement, permit holders may elect to use permanent or retrievable bridge plugs, permanent or retrievable packers with a plug in the packer, or a non-activated cement retainers, provided that all other requirements are met, including pressure testing of the platform. Note that at all times, responsibility for the well and well operations remains with the permit holder, including responsibility to re-enter the well should repairs be necessary.

## 4.5 Noncompleted Wells Without Liners

Noncompleted wells without liners (ie. only have full-length casing) must be pressure tested as described in section 5.2. If the well is pressure tested successfully, no additional plugs are required. Note that remedial operations may still be required.

## 4.6 Zonal Abandonment in a Completed Well

Permit holders must determine which of the following categories a completed interval proposed for abandonment belongs to:

- Non-Level A, non-high pressure;
- Non-Level A, high pressure;
- Level A intervals; including wells completed in an acid gas disposal pool but not used for acid gas disposal;

After determining which category a completed interval belongs to, permit holders must abandon the completed interval using one of the options outlined below.

**Please Note:**

Numerous sections in this chapter refer to conducting cement squeezes. Permit holders should consider the formation fracture pressure of any interval being treated when designing a cement squeeze.

### 4.6.1 Capping a Bridge Plug with Cement (Non-Level A Intervals)

A bridge plug must be set as described in section 4.4 and pressure tested as described in section 5.2. The plug must be capped with either a minimum of 8 vertical metres class "G" cement, or a minimum of 3 vertical metres resin-based low-permeability cement.

**Additional requirements for high pressure intervals:** The cement cap must be a minimum of 60 vertical metres in length, have a minimum volume of 1 $m^3$, and be circulated in place.

### 4.6.2 Capping a Bridge Plug with Cement (Level A Intervals, Non-Routine)

A cement evaluation log must be run from the proposed bridge plug setting depth to a minimum of 60 metres above the formation top. The bond log and an interpretation from a qualified professional must be submitted to the Regulator for review. If the interpretation confirms that isolation exists, the permit holder must set a bridge plug less than 15 vertical metres above the completed interval. The bridge plug must then be pressure tested as described in section 5.2. The plug must be capped with a class "G" cement plug that is:

- Circulated in place,
- Minimum 60 vertical metres in length,
- Extends a minimum of 60 vertical metres above the formation top, and
- Has a minimum volume of 1 $m^3$.

### 4.6.3 Setting a Cement Plug or Squeezing Cement (Non-Level A Intervals)

A cement plug must be circulated in place that extends from at least 15 vertical metres above and below the completed interval. One or more completed intervals may be covered by a single cement plug. The location of the plug must be verified using one of the methods described in section 5.1. The plug must be pressure

tested as described in section 5.2. Permit holders should use best practices when circulating to ensure plug stability, which may include placing a mechanical plug to act as a competent base to prevent the cement from settling due to density differences.

If the permit holder elects to apply a squeeze pressure to the cement, the Regulator recommends that the final squeeze pressure be a minimum of 7000 kPa above the current reservoir pressure of the highest pressure completed interval.

**Additional requirements for high pressure intervals:** The cement plug must extend a minimum of 60 vertical metres above the top of the uppermost completed interval, have a minimum volume of 1 $m^3$ and be circulated in place.

### 4.6.4 Squeezing a Cement Plug (Level A Intervals)

A cement plug must be circulated in place and squeezed into the completed interval. This plug must also:

- Extend from at least 15 vertical metres below the completed interval to at least 30 vertical metres above the formation top;
- Have a minimum volume of 1 $m^3$;
- Be squeezed to a minimum of 7000 kPa above the current reservoir pressure of the interval being abandoned;
- Have its location verified using one of the methods described in section 5.1;
- Be pressure tested using one of the methods described in section 5.2.

Permit holders should use best practices when circulating to ensure plug stability, which may include placing a mechanical plug to act as a competent base to prevent the cement from settling due to density differences.

### 4.6.5 Squeezing Cement Using a Cement Retainer (Non-Level A Intervals)

A cement retainer must be set less than 15 vertical metres above the completed interval. The retainer must be pressure tested as described in section 5.2. A cement squeeze must be conducted through the retainer, meeting the following requirements:

- The minimum cement volume must equal the casing volume from the bottom of the retainer to the bottom of the completed interval, plus 0.5 $m^3$; and
- The final squeeze pressure must be a minimum of 7000 kPa above the current reservoir pressure of the interval being abandoned.

The retainer must be capped with a minimum of 8 vertical metres class “G” cement, or a minimum of 3 vertical metres of resin-based low-permeability cement

### 4.6.6 Squeezing Cement Using a Cement Retainer (Level A Intervals)

A cement retainer must be set less than 15 vertical metres above the completed interval. The retainer must be pressure tested as described in section 5.2. A cement squeeze must be conducted through the retainer, meeting the following requirements:

- The minimum cement volume must equal the casing volume from the bottom of the retainer to the bottom of the completed interval, plus 0.5 $m^3$; and
- The final squeeze pressure must be a minimum of 7000 kPa above the current reservoir pressure of the interval being abandoned.

The retainer must be capped with a class “G” cement plug that:

- Is circulated in place,
- Is a minimum 30 vertical metres in length,
- Extends a minimum of 30 vertical metres above the formation top, and
- Has a minimum volume of 1 $m^3$.

## 4.7 Wells with a Cemented Liner

Completed intervals located below the liner top of a cemented liner must be abandoned as described in section 4.6. Following abandonment of the completed intervals, the permit holder must abandon the liner top using one of the following options.

### 4.7.1 Capping a Bridge Plug with Cement (Non-Level A Intervals)

For liners where the associated completed interval is not Level A, the liner top must be abandoned with a bridge plug set as described in section 4.4 and pressure tested as described in section 5.2. The plug must be capped with either a minimum of 8 vertical metres class “G” cement, or a minimum of 3 vertical metres resin-based low-permeability cement.

**Additional requirements for high pressure intervals:** If the completed interval within a cemented liner is a high pressure interval, the cement cap above the liner top must be a minimum of 60 vertical metres in length, have a minimum volume of 1 $m^3$ and be circulated in place.

### 4.7.2 Capping a Bridge Plug with Cement (Level A Intervals, Non-Routine)

For liners where the associated completed interval is Level A, a cement evaluation log must be run from the proposed bridge plug setting depth to a minimum of 60 metres above the formation top. The bond log and interpretation must be submitted to the Regulator for review. If isolation is confirmed, the permit holder must set a bridge plug less than 15 vertical metres above the liner top. The bridge plug must then be pressure tested as described in section 5.2. The plug must be capped with a class "G" cement plug that is:

- Circulated in place,
- Minimum 60 vertical metres in length,
- Extends a minimum of 60 vertical metres above the formation top, and
- Has a minimum volume of 1 $m^3$.

### 4.7.3 Setting a Cement Plug or Squeezing Cement

A cement plug must be circulated in place that extends from at least 15 vertical metres above and below the liner top. The circulated cement plug must also extend a full casing joint above the liner top. The location of the plug must be verified using one of the methods described in section 5.1. The plug must be pressure tested as described in section 5.2. Permit holders should use best practices when circulating to ensure plug stability, which may include placing a mechanical plug to act as a competent base to prevent the cement from settling due to density differences.

If the permit holder elects to apply a squeeze pressure to the cement, the Regulator recommends that the final squeeze pressure be a minimum of 7000 kPa above the current reservoir pressure of the highest pressure completed interval isolated by the liner.

**Additional requirements for high pressure intervals and Level A:** If the completed interval within a cemented liner is a high pressure or Level A interval, the cement plug must extend a minimum of 60 vertical metres above the liner top, have a minimum volume of 1 $m^3$ and be circulated in place.

## 4.8 Wells with an Uncemented Liner

Permit holders must evaluate the entire wellbore behind an uncemented liner for the presence of porous intervals. Permit holders must design and execute remedial operations sufficient to establish isolation between any identified porous intervals. Once all porous intervals along the liner have been isolated, permit holders must abandon the liner top using one of the methods described in section 4.7.

## 4.9 Open-hole Completions in Horizontal Wells

Permit holders must determine whether a horizontal well with an open-hole completion is within a single formation or across multiple formations. Permit holders must then determine which of the following categories each formation proposed for abandonment belongs to:

- Non-Level A, non-high pressure;
- Non-Level A, high pressure;
- Level A intervals; including wells completed in an acid gas disposal pool but not used for acid gas disposal;

Permit holders must then abandon the open-hole completion as described below.

### 4.9.1 Single Formation Horizontal Wells

The permit holder must abandon the open-hole completion using one of the methods described in section 4.6. Any mechanical plugs being placed as part of a zonal abandonment program must be placed at a depth less than 15 vertical metres above the formation top of the completed interval. If the mechanical plug is set within the open-hole section, the cement plug must be circulated in place and extend a minimum of 15 vertical metres above the next casing shoe, as well as extending at least one full casing joint above the casing shoe.

### 4.9.2 Multiple Formation Horizontal Wells

Permit holders must assess the length of the open-hole completion and identify all porous intervals. Permit holders must then cover or isolate each porous interval as described in section 3.2. The locations of all cement plugs must be verified as described in section 5.1.

**Please Note:**

Where a well has been drilled with multiple legs within a single or multiple formations, each leg *may* need to be isolated from the others. Permit holders are encouraged to consult with the Regulator's Drilling and Production staff prior to submitting an NOO for these types of wells.

## 4.10 Casing Failures, Previously Cement Squeezed Intervals

Permit holders must abandon casing failures, including casing patches and previously cement squeezed intervals, by using one of the options identified in section 4.6. For casing failures that occur over more than one porous interval, a cement squeeze must be conducted as described under section 4.6.3 or 4.6.4. For previously cement squeezed intervals that are over more than one porous interval, each zone must be isolated separately.

## 4.11 Surface Casing Vent Flow, Gas Migration Repair

Permit holders should refer to section 9.7.3 of the Oil and Gas Activity Operations Manual for assistance in determining whether a SCVF is Serious or Non-Serious. The permit holder of a well with a Non-Serious SCVF may repair the SCVF at any time prior to completing surface decommissioning of the well. Serious SCVFs must be reported immediately and repaired as required by the Regulation.

The permit holder of a well with GM may defer repairs to time of well decommissioning, provided a completed risk assessment supports that deferral. Refer to section 9.7.6 of the Oil and Gas Activity Operations Manual for requirements related to GM risk assessment.

Permit holders must determine the source and cause of a SCVF or GM prior to conducting remedial operations. This may include some or all data points referred to in DACC IRP #27 – Wellbore Decommissioning.

For a proposed SCVF or GM repair program to be considered routine, it must be designed and executed as shown below. Other, non-routine, repair programs may be appropriate if the permit holder is able to demonstrate the equivalency of their proposal as described in section 1.3. However, the pumping of any type of fluid down the surface casing annulus is not an acceptable means of repair.

### Please Note:

Section 41 (2) of the Drilling and Production Regulation requires permit holders to check for the presence of SCVF prior to abandoning a well and submit the results to the Regulator. Refer to section 9.7.3 of the Oil and Gas Activity Operations Manual for the recommended test procedure. Refer to Chapter 6 of the eSubmission User Guide for instructions on submitting test results, including test results confirming a SCVF has been repaired.

## 4.11.1 Routine SCVF or GM Repairs

A SCVF or GM repair is routine if all the following conditions are met:

- The source depth or formation of origin is determined, incorporating appropriate combinations of fluid analysis, diagnostic logging, geological interpretation, or other factors in IRP 27;
- The SCVF or GM is stopped or eliminated by perforating either;
    - Below the source and circulating cement across the source formation, or
    - At the source or the barrier immediately above the source and performing a cement squeeze.
- The repair is attempted below the BUGW and 15 metres below the surface casing shoe;
- The cement and any additives used must meet the cement requirements of section 1.3;
- The repair does not use deformative or destructive measures that will restrict or eliminate access to the casing below the repair depth if the repair is unsuccessful;
- If the interval being remediated meets the definition of a Level A interval, the additional requirements related to the zonal abandonment of Level A intervals are followed;
- If a feed rate cannot be established, the perforations must be abandoned as though they were a completed interval

Following completion of SCVF or GM repairs, permit holders must test for the presence of SCVF or GM as described in section 9.7.3 of the Oil and Gas Activity Operations Manual. If the SCVF or GM has not been remediated, additional repairs will be required.

### Please Note:

Sections in this Chapter make reference to “perforate” and “perforations”. For the purposes of accessing the annular space behind a string of casing, permit holders may elect to use alternative access techniques as appropriate for a particular well, provided it does not restrict access to the casing below the treatment depth.

## 4.12 Groundwater Protection

Permit holders must determine the Base of Usable Groundwater (BUGW) as described in INDB 2016-09. Where a length of the wellbore above the BUGW has not been covered by cement, remedial activities must take place, using one of the following options.

### 4.12.1 Removing Casing and Setting a Cement Plug (Non-Routine)

If the casing is free below the BUGW, the permit holder may cut and pull the casing. Casing removal programs that meet the following requirements are routine. Any casing other than the surface casing may be removed in this manner.

The cut point must be identified at or below the BUGW. A bridge plug must be set a minimum of 15 vertical metres below the intended cut point. The bridge plug must be pressure tested as described in section 5.2. The casing must be cut and retrieved at the point identified. Once the casing is cut and pulled, a cement plug must be circulated in place from the bridge plug to a minimum of 15 vertical metres above the surface casing shoe.

**Please Note:**

Casing removal and setting a cement plug may only be completed after all other downhole abandonment operations have been completed successfully. If the casing cannot be removed from the well, the Regulator's Drilling and Production staff must be contacted.

## 4.12.2 Remedial Cementing

The permit holder may access the annular space behind casing by perforating the casing at the BUGW and attempt to establish circulation to surface with non-saline water. A maximum of 1 $m^3$ of acid may be used to establish circulation.

If circulation to surface is successful, the permit holder must circulate cement to surface by one of the following methods:

- Setting a retainer less than 15 metres above the perforations. The retainer must be pressure tested as described in section 5.2. Cement must be circulated to surface through the retainer. The retainer must then be capped with a minimum of 8 vertical metres of cement.
- Setting a bridge plug as close as possible below the perforations. Cement must be circulated to surface through the perforations. The cement top left inside the casing must be a minimum of 15 vertical metres above the perforations. The plug must be pressure tested as described in section 5.2.

If circulation to surface is unsuccessful, the permit holder must attempt to establish a feed rate. If a feed rate can be established, cement must be squeezed into the perforations, using one of the following methods:

- Setting a retainer less than 15 metres above the perforations. The retainer must be pressure tested as described in section 5.2. Following the cement squeeze, the retainer must be capped with a minimum of 8 vertical metres of cement.
- Circulating a cement plug in place, from at least 15 vertical metres below the perforations, to at least 15 vertical metres above the perforations. Following the cement squeeze, the location of the plug top must be verified using one of the methods described in section 5.1. The plug must be pressure tested as described in section 5.2.

If a feed rate cannot be established, the perforations must be abandoned as though they were a completed interval.

### Please Note:

Section 21 of the Drilling and Production Regulation prohibits permit holders from conducting fracturing operations at a depth less than 600 metres below ground level, unless the operations are permitted by the well permit. Cement squeezes conducted as part of SCVF, GM or BUGW remediation must be conducted at pressures less than fracture pressure.

## 4.13 Use of Alternative Materials and Techniques

In some circumstances, permit holders may wish to pursue alternative materials and/or techniques to conduct zonal abandonment or remedial operations. The use of materials or techniques not described in this Guideline will always be non-routine and must be reviewed with the Regulator's Drilling and Production staff prior to submitting a Notice of Operations. Permit holders should qualify any proposed alternative material or technique according to industry best practices. Permit holders will be expected to demonstrate that a proposed alternative improves on the reliability and/or longevity of well decommissioning practices.

# Chapter 5: Logging and Testing Requirements

## 5.1 Cement Plug Verification

Where required in Chapters 3 and 4, the location of cement plugs must be verified using one of the options shown below.

### 5.1.1 Tagging with Drill Pipe or Work String

The location of the plug top must be verified by tagging the top of the plug and conducting a strap tally of the drill pipe or work string. The minimum force with which the plug must be located is 1800 daN, or string weight, whichever is less. This method may only be used after a minimum 8 hours have elapsed from the time the plug was run, or after surface samples have set. For each plug verified, the permit holder must document the following in the Tour Sheet or Completion/Workover Report:

- Cement type, mass and slurry volume;
- Drill pipe, work string or coiled tubing setting depth, including the strap tally and any adjustments made;
- Force applied to the plug;
- Date and time of plug verification.

**Please Note:**

Tagging with wireline or slickline is NOT an acceptable means of verifying the location of a cement plug.

### 5.1.2 Direct Density or hydrostatic pressure Plug Logging

The location of the plug top must be verified by direct density measurement or by fluid gradient measurement. Tools must be calibrated according to the manufacturer's recommendation. The difference between the cement density and the density of the drilling or workover fluids must be at least 300 kg/m$^3$. A minimum of 25 vertical metres of cement slurry must be logged to determine the plug top. The position of the plug top shall be interpreted to be a depth where the measured density is at an appropriate intermediate density between the drilling or workover fluid and the cement slurry.

The resulting log shall:

- Show fluid density, fluid gradient or cement percentage with depth;
- Indicate the densities of the drilling fluid and cement slurry;
- Show the serial number, range and date of last calibration of the logging tool;
- Be submitted to the Regulator via eSubmission.

### 5.1.3 Radioactive Tracer Logging

The location of the plug top must be verified by including a radioactive tracer in the lead cement slurry and logging the cement top using a gamma ray logging tool. Adequate precautions must be taken to properly mix the tracer with the slurry and permit holders should consider using spacer fluids to prevent channeling. The resulting log shall:

- Indicate the location of the tracer, which shall be taken as the top of the plug;
- Show the serial number, range and date of last calibration of the logging tool;
- Be submitted to the Regulator via eSubmission.

## 5.2 Mechanical and Cement Plug Pressure Testing

Where the casing, a mechanical plug or cement plug must be pressure tested, it shall be tested to a minimum of 7000 kPa over hydrostatic pressure at the plug back depth and the pressure shall be monitored for 10 minutes. If the pressure after 10 minutes is stable, with a rate of pressure change approaching 0 and does not otherwise indicate a loss of integrity of either the plug or the casing, then abandonment operations may proceed. If the pressure test is not successful, the permit holder must investigate the cause of the failed test and remedy it. If a pressure test is being conducted on a plug isolating an overpressured formation, permit holders are encouraged to test to 7 mPa over formation pressure and if practical, conduct a negative pressure test.

# Chapter 6: Surface Decommissioning

## 6.1 Overview

Surface decommissioning is the cutting off of casing strings below ground level and the installation of a cap to prevent accidental access to the wellbore. Surface decommissioning of a well must not take place until all downhole requirements from Chapter 3 or 4, as appropriate, have been met. In addition, final testing requirements, identified below, must be met prior to conducting the final cut and cap of a well.

If surface decommissioning of an open-hole or cased-hole well are not reported as part of a downhole abandonment program, a separate Notice of Operations and Completion/Workover Report must be submitted for surface decommissioning activities, as described in section 1.2.

## 6.2 Fluids Within the Wellbore

The casing must be filled with non-saline water from the uppermost abandonment plug to surface. Where one or more abandonment plugs are above the BUGW, the casing must be filled with non-saline water from the first plug below the BUGW to surface. Corrosion inhibitors must not be used inside the casing above the BUGW.

For segments of the wellbore below the BUGW that are isolated from the BUGW by one or more abandonment plugs as described in Chapter 4, the casing may be filled with an inhibited or non-corrosive fluid, or non-saline water.

## 6.3 Open-hole Fluid Level Testing

Prior to completing surface decommissioning activities on a well that was downhole abandoned as described in Chapter 3, a permit holder must conduct a fluid level test to determine if there are any leaks. The fluid level test must be performed a minimum of 5 days after the completion of downhole activities. To perform the test, the permit holder must visually inspect the well to ensure that the fluid level is static and no fluids are escaping from the well. In the event the fluid level is not static or fluids are seen to be escaping from the well, the permit holder must re-access the well and remedy the leaking plugs, along with completing all notification, reporting and testing requirements.

## 6.4 Geotechnical Stability

Prior to completing surface decommissioning activities on a well, a permit holder must assess whether the wellsite or surrounding areas present a geotechnical hazard to the well's long-term integrity, such as slope instability or ground movement. Permit holders should consider all factors that may contribute to the geotechnical hazard, including but not limited to:

- The potential existence of unfavorable soil deposits, such as glaciolacustrine clay;
- The presence of slide-prone or unstable terrain, evident by historical landslides or ground movement in the area;
- The presence of steep slopes near or at the wellsite, especially where such slopes are cleared of trees or other vegetation, which enhances the upstream water surcharge;
- The presence of large unlined water reservoirs / ponds or dams upstream of the wellsite that enhances upstream surcharge and subsequently compromises slope stability;
- Proximity to nearby rivers, streams, seasonal flows or other bodies of water, especially those subject to changes in water level or high flow, with the potential to cause undercut or erosion at slope toe;
- The susceptibility of the soil underlying (or adjacent to) the wellsite to freeze/thaw cycles.

In cases where geotechnical stability is uncertain or presents a hazard, permit holders must mitigate the risk presented by the instability, which may include additional casing cuts to allow for lateral movement of the casing following surface decommissioning, or special cement blends with added flexibility.

## 6.5 Surface Casing Vent Flow Testing

A SCVF check must be completed prior to the cutting and capping of a completed or cased well. This check should take place after the completion of downhole abandonment activities. If the check indicates there is an ongoing SCVF, surface decommissioning must not take place. The results of an SCVF check must be reported to the Regulator using eSubmission, regardless of the result. Refer to section 9.7.3 of the Oil and Gas Activity Operations Manual.

## 6.6 Gas Migration Testing

Permit holders are strongly encouraged to check for the presence of GM prior to conducting surface decommissioning activities, particularly for wells with an existing or previously repaired SCVF, or which experienced well control problems during drilling. If the check confirms the presence of GM, surface decommissioning activities must not take place. Permit holders should submit the results of a check for the presence of GM to the Regulator using eSubmission, and submission of the results is required if the presence of GM is confirmed. Refer to section 9.7.3 of the Oil and Gas Activity Operations Manual for further information.

## 6.7 Cutting and Capping

The casing strings must be cut off a minimum of 1 metre below the final contour elevation, with the following exceptions:

- If the well is in an area with special farming practices, is within 15 km of an urban development, or if it is requested by the landowner, the casing must be cut off a minimum of 2 metres below the final contour elevation.
- If the well is located in an area where surface mining will be conducted, a cement plug must be circulated from the uppermost abandonment plug to 15 vertical metres below the intended strip mining depth. Above the strip mining depth, the casing must be cut at intervals agreed to by the mine operator.

All casing strings must be capped at surface with a vented cap - a steel plate that is fastened and installed in a manner to prevent both the buildup of pressure within the casing strings and access to the casing strings from surface. Flat and "wedding cake" style cut and cap designs are acceptable.

Permit holders must weld accurate identifying information on either the cap or the casing stub. This identification must consist of one of the following:

- 6-digit WA number (eg WA 000191)
- Surface location, including exception code (eg A10-04-083-17)

Permit holders must photograph the casing stub and clearly show the correct identifying information welded on the cap or casing stub. The photograph must be submitted as part of the Completion/Workover Report.

### 6.7.1 Cut and Cap not Previously Reported

Where a well was cut and capped but not reported to the Regulator at the time the work was completed, the Regulator will accept one of the following as evidence of surface decommissioning:

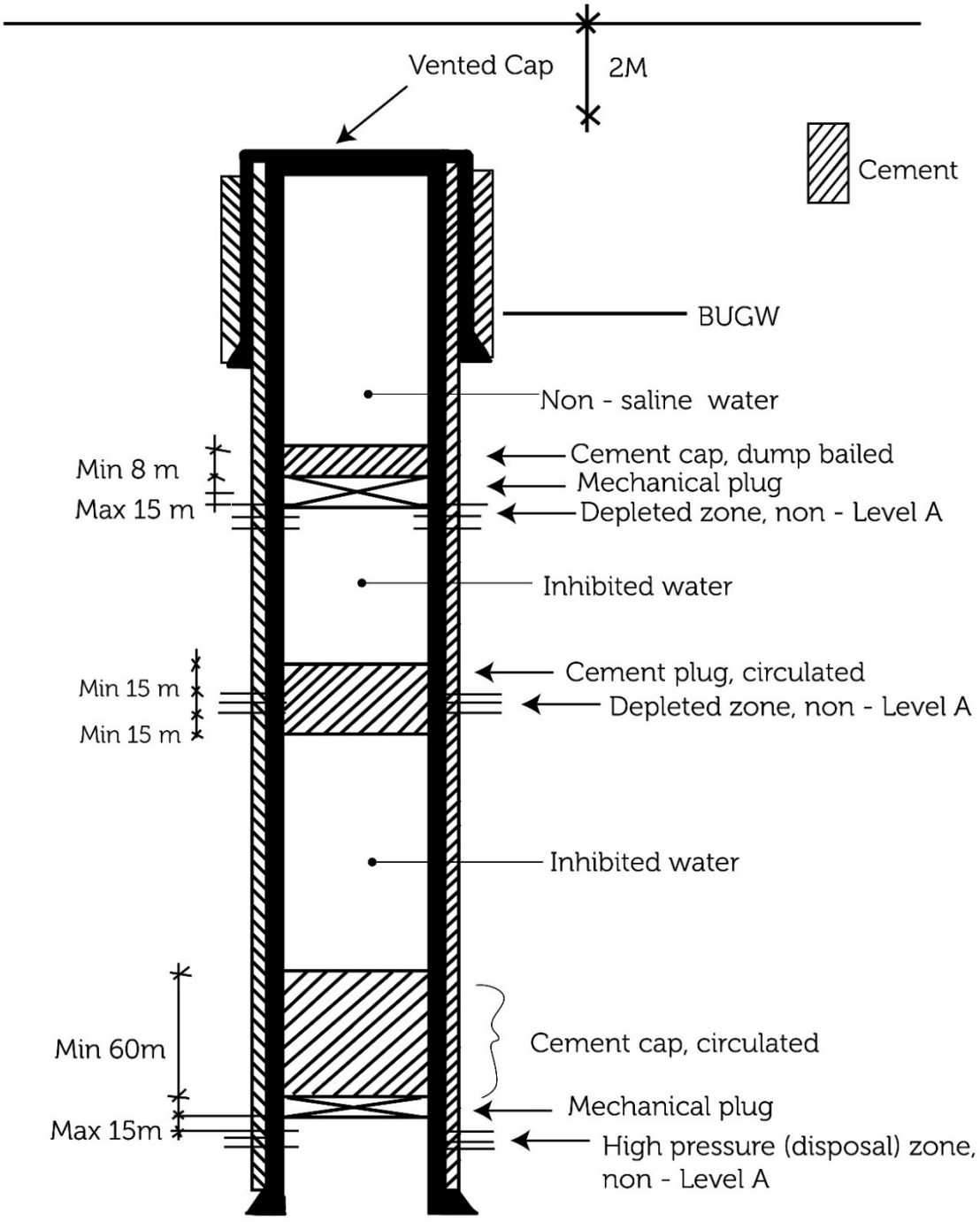
- A photograph of the signpost (grave marker) and wellsite. The signpost must contain adequate identifying information. Note that grave markers are no longer required when decommissioning wells.
- Copies of invoices, welder's tickets or equivalent documenting the cut and cap. The documentation must unambiguously identify the site being decommissioned.

Where a well was cut and capped prior to January 1, 2011, all of the following may be completed instead:

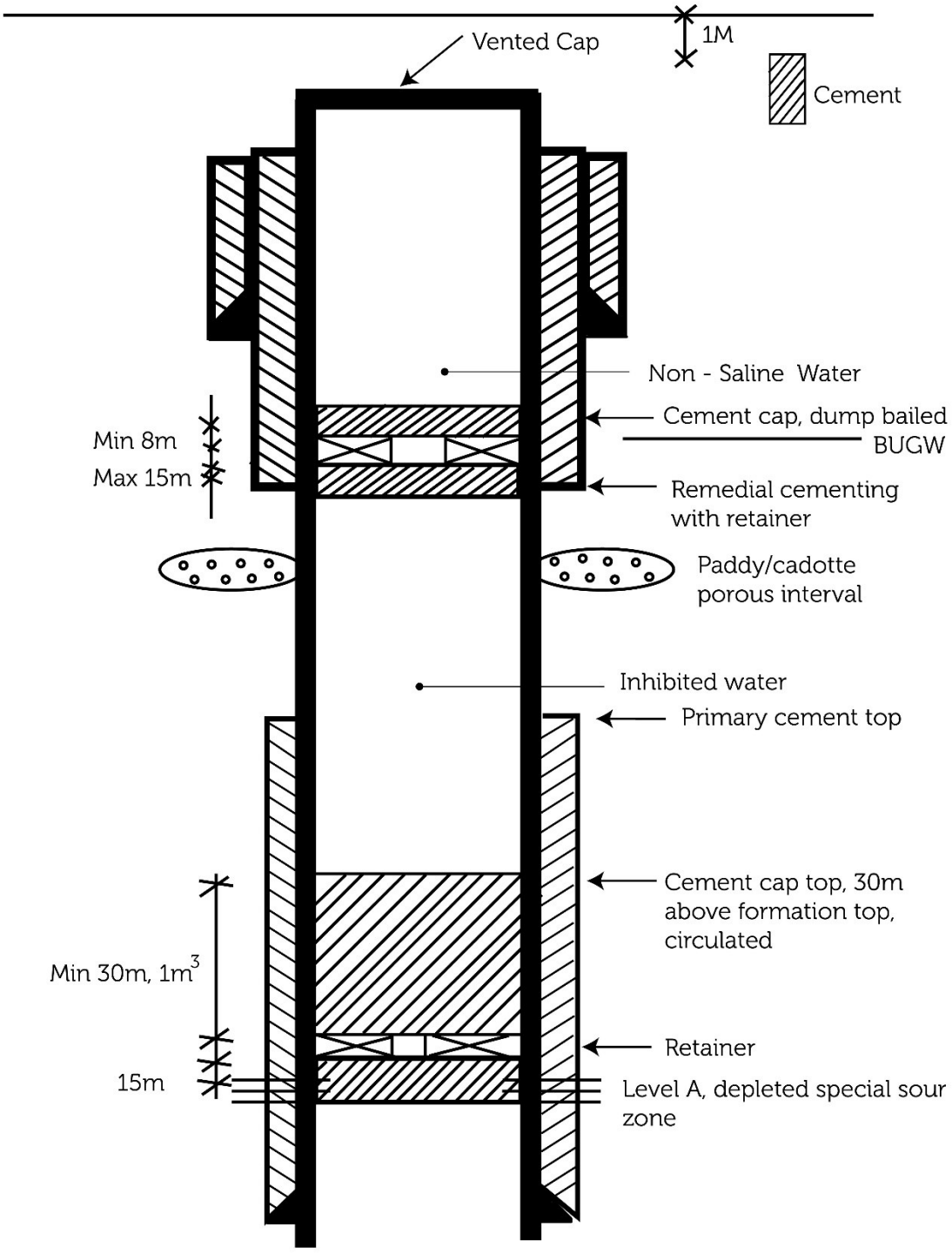
- Verify well location by use of a metal detector or pin finder. The coordinates must be documented by way of a photograph of a GPS readout or equivalent.
- Conduct and document a Soil Gas Survey to ensure there are no indications of well leakage.

If the above are unavailable, permit holders must excavate and photograph the casing stub, including the identifying information welded on the cap or casing stub.

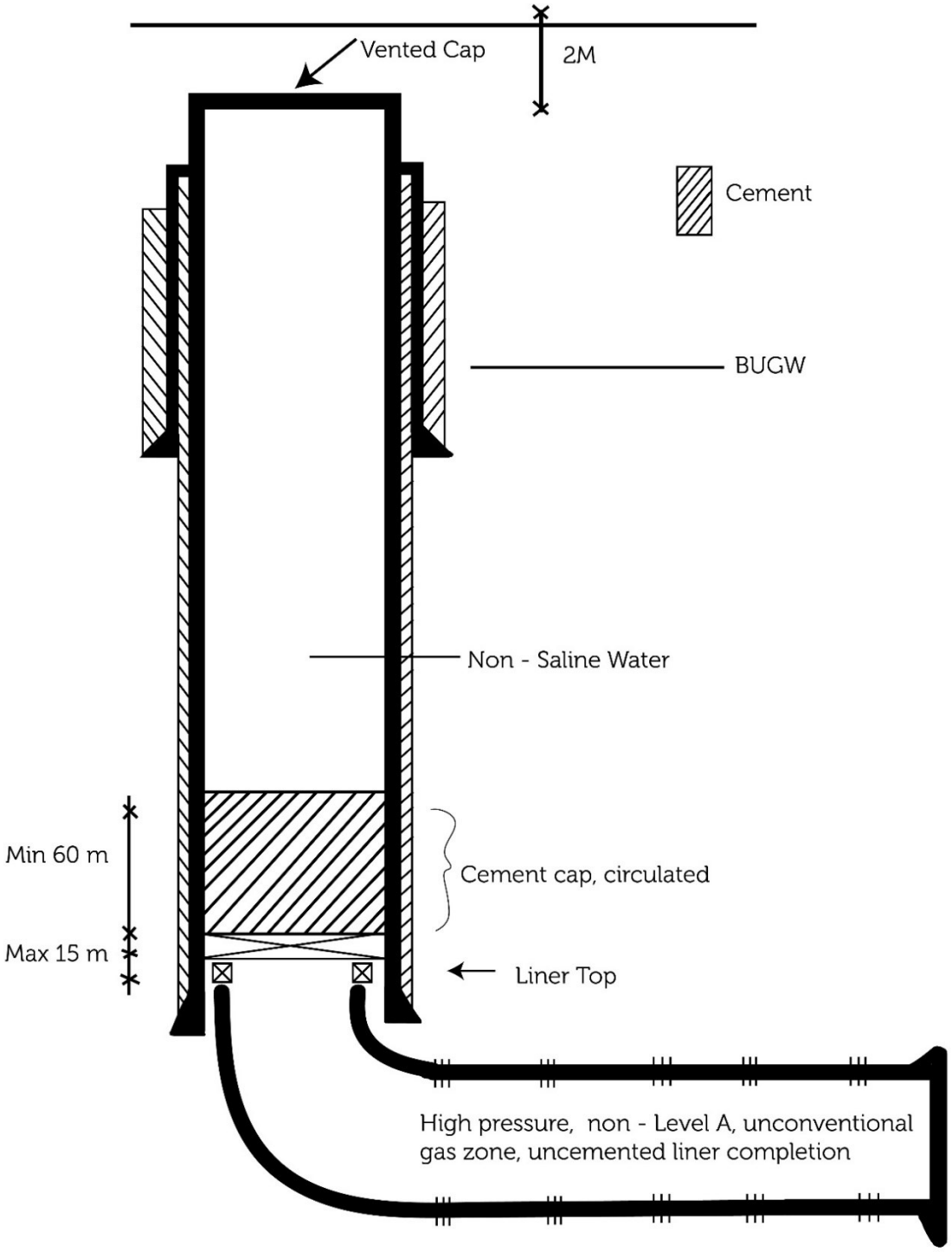
# Appendix A: Examples of Decommissioned Cased Wells




Example of a decommissioned cased well with 3 non-level A zonal abandonments.




Example of a decomissioned case well with 1 Level A zonal abandonment and remedial cementing




Example of a decommissioned cased well with 1 high pressure, non-Level A zoned abandonment.

# Appendix B: Examples of Disposal Fluids Requiring Level A Zonal Abandonment

Schedule 1 — Heavy Metals Criteria

| Metal | Concentration (mg/kg) |
|---|---|
| Arsenic | 500 |
| Beryllium | 100 |
| Cadmium | 100 |
| Chromium | 500 |
| Lead | 500 |
| Mercury | 20 |
| Nickel | 500 |
| Selenium | 200 |
| Silver | 100 |
| Thallium | 200 |
| Uranium | 100 |

- saline fluids as obtained from oilfield waste processing facilities, oilfield tank washing operations, oil spill containment and recovery, or similar operations
- boiler blowdown water
- liquid fraction of drilling muds, including KC1 muds, but excluding diesel inverts (in accordance with section 2.3)
- aqueous liquid fractions of spent sweetening agents - neutralized (Cansweet 200, 300, 300SX, 500, SulphaCheck, Sulfa-Scrub)
- amine filter backwash (eg. MEA, DEA, MDEA)
- sulphur block run-off water - neutralized
- inorganic salts used in heat exchange medium (eg. sodium/potassium nitrates/ nitrites), properly solubilized using an existing aqueous waste stream
- waste fluids from drilling operations (i.e. used in or originating from the wellbore)
- spent workover or stimulation fluids (after neutralization and/or processing to recover hydrocarbons)
- glycol solutions as obtained from dehydration operations
- methanol or hydro-test solutions
- acidic or alkaline solutions (neutralized) with heavy metal concentrations at or below the levels given in Schedule 1
- gas scrubber or absorption tower bottom liquids (neutralized) with heavy metal concentrations at or below the levels of Schedule 1
- washing waste water (ie. detergent or soap wastes)
- corrosion inhibitor solutions with heavy metal concentrations at or below Schedule 1 levels
- oxygen scavenger solutions with heavy metal concentrations at or below Schedule 1 levels

- acidic or caustic solutions
- acidic solutions with heavy metals above the concentrations given in Schedule 1
- alkaline solutions with heavy metals above the concentrations given in Schedule 1
- aqueous solutions with heavy metals above the concentrations given in Schedule 1
- metal-finishing solutions (acidic, alkaline, or spent pickle liquors)
- solutions containing reactive anions (includes fluoride, hypochlorite, bromate)
- aqueous solutions containing non-halogenated organic compounds in concentrations less than 10 per cent by mass
- aqueous solutions containing halogenated organic compounds (excluding PCBs) in concentrations less than 0.1 per cent by mass
- pesticide waste water
- herbicide waste water
- aqueous solutions containing less than 50 mg/l of PCBs
- pharmaceutical waste water
- liquid tannery waste water
- phenolic waste waters
- oil refinery waste water
- chemical process waste water
- contaminated surface run-off water that is untreatable and unsuitable for return to the watershed
- asbestos slurries
- alum and gypsum slurries
- metal (heavy and non-) slurries
- spent photo-finishing solutions