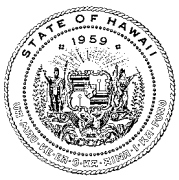
Department of Land and Natural Resources

COMMISSION ON WATER RESOURCE MANAGEMENT

HAWAII
Well Construction
& Pump Installation
STANDARDS

Honolulu, Hawaii
Revised February 2004



Linda Lingle
Governor

DEPARTMENT OF LAND AND NATURAL RESOURCES

COMMISSION ON WATER RESOURCE MANAGEMENT

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2nd Edition February 2004

FOREWORD

About 50 percent of Hawaii's water supply comes from ground-water sources. Ground water, which is also used for agricultural, industrial, and domestic purposes, is the principal source of municipal water supplies in Hawaii. Consequently, protecting the quality and quantity of ground water throughout the State is essential to Hawaii's future well being.

Improperly and inadequately constructed wells can cause pollution or increase the chances of salt-water intrusion to ground-water sources to the point of requiring cessation of use or expensive treatment before use. The Hawaii State Water Code and the Administrative Rules of the Department of Land and Natural Resources require the Commission on Water Resource Management to develop minimum standards for the construction, modification, repair/maintenance, and sealing/abandonment of wells in order to protect the quality and quantity of Hawaii's ground-water resources.

The State Department of Health and county water supply departments also play a critical role in maintaining drinking water sources and protecting ground-water quality. Consequently, these government agencies may have adopted or may adopt in the future more stringent standards for wells than are provided in these statewide minimum standards.

ACKNOWLEDGMENTS

1997 Edition

These standards were prepared after consideration of all comments and suggestions from private parties and public agencies. Private parties included individuals, well drillers, water users, and consultants. Public agencies included county water departments, State Department of Health, and State Department of Land and Natural Resources (Land Division).

Many comments and suggestions were received orally at public hearings and in writing and the Commission on Water Resource Management wishes to thank all for their time and effort during the review process.

2004 Edition

Many companies, agencies and individuals provided comments, advice and help in revising these Standards (Table 1). The Commission on Water Resource Management thanks all those who contributed to the review.

Table 1. Participation in the 2003-2004 Review Process

Written Comments	Participation in Public Meetings	Verbal Comments
Department of Health, Safe Drinking Water Branch and Underground Injection Control	Beylik Drilling	Oasis Water Systems, Inc.
Hawaii County Department of Water Supply	Department of Health, Safe Drinking Water Branch and Underground Injection Control	Tracy Runnells Well Service Inc.
Honolulu Board of Water Supply	Department of Land and Natural Resources, Engineering Division	Valley Well Drilling
Mink and Yuen, Inc.	Hawaii County Department of Water Supply	
Wai'eli Drilling	Island Resources, Ltd.	
	James A. Frazier	
	Kauai Department of Water Supply	
	Limtiaco Consulting Group	
	Maui Department of Water Supply	
	Herbert M. Richards, Jr	
	U.S. Geological Survey	
	Wai'eli Drilling	
	Water Resources International, Inc.	

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GENERAL PROVISIONS

Part 1.
GENERAL PROVISIONS

Section 1.1 Purpose and Scope

These Standards shall be known as the Hawaii Well Construction and Pump Installation Standards (2004) of the Department of Land and Natural Resources and are referred to hereinafter as the "Standards."

These Standards establish minimum requirements for the purpose of protecting and preventing the pollution, contamination, and wasting of ground water and for the purpose of minimizing saltwater intrusion into wells and ground water in the State of Hawaii in the course of:

Construction of wells,
Modification of wells,
Abandonment and permanent sealing of wells and test borings, and
Installation and repair of pumps.

These Standards apply to all wells constructed for the purpose of locating, exploring, monitoring, developing, or recharging of ground-water aquifers. These minimum Standards do not preclude other enforcing agencies, state or county, from establishing more stringent standards to meet their objectives. These Standards also do not replace or define the regulatory permitting process.

Section 1.2 Authority

Under § 174C-82, Hawaii Revised Statutes, the Commission must develop these Standards. These Standards fulfill § 174C-86 of the State Water Code (Hawaii Revised Statutes) and Hawaii Administrative Rules § 13-168-14, which reads as follows:

§13-168-14 Well construction and pump installation standards. (a) The minimum standards referenced in this section, shall be such as to ensure the safe and sanitary maintenance and operation of wells, the prevention of waste, and the prevention of contamination of ground-water aquifers. The standards for well construction specified in The

Hawaii Well Construction and Pump Installation Standards, adopted by the Commission on Water Resource Management, and as may be amended, is hereby incorporated by reference.

(a) The minimum standards for the installation of pumps and pumping equipment shall also provide for the installation of devices to measure the amount of ground water being withdrawn from the wells. The Hawaii Well Construction and Pump Installation Standards, as may be amended, is hereby incorporated by reference.

(b) The well construction and pump installation standards referenced in this section shall serve as minimum guidelines and shall be subject to review and modification by the Commission.

(c) If any well construction, well abandonment or pump installation standard is violated and as a consequence ground water is wasted or any well is contaminated, the Commission, after giving notice of the defect to the owner of the land on which the well is located, and giving such owner a reasonable time to correct the defect, may itself correct the defect and charge the land owner for the cost of such correction. Such cost constitutes a lien on the land until paid. The lien may be foreclosed in any court of competent jurisdiction, and in such foreclosure suit, the court shall allow the Commission reasonable attorney's fees. [Eff. March 21, 1997] (Auth: HRS §174C-8) (Imp: HRS §174C-82, 174C-86)

Section 1.3 Standards of Other Agencies

(a) **New Drinking Water Wells**

In addition to the requirements of these minimum Standards, all wells to be used to supply a public water system must meet the requirements of the State Department of Health, Safe Drinking Water Branch, under their rules, Title 11, Chapter 20, entitled "Rules Relating to Potable Water Systems" and as may be amended.

Also, for wells intended for municipal use, please be aware of the well construction standards in “Water System Standards, State of Hawaii”, 2002 as amended and the American Water Works Association (AWWA) Standards for Water Wells, ANSI/AWWA A100-97, as amended.

(b) **Injection (Drainage) Wells**

Injection wells are not governed by these Standards. The location, abandonment, construction, and operation of injection wells must meet the permit requirements of the State Department of Health, Safe Drinking Water Branch under their rules, Chapter 11-23, "Underground Injection Control, "as amended. The Commission does not require a permit for the construction and operation of injection wells.

(c) **Geothermal Wells**

Geothermal wells are not governed by these Standards. Geothermal wells must meet the permit requirements of the Department of Land and Natural Resources, Engineering Division under their rules, Title 13, Chapter 183, "Rules on Leasing and Drilling of Geothermal Resources," as amended. The Commission does not require a permit for geothermal wells.

(d) **Test Borings**

The Commission does not require a permit for temporary test borings and test boring sealings. However, test borings related to underground storage tanks and environmental monitoring or remediation must meet the requirements of the State Department of Health. Permanent test borings for long-term monitoring of water levels and/or chlorides are considered monitoring wells, which require a well construction permit from the Commission.

Section 1.4 Definitions

The following definitions shall apply in the interpretation of these Standards:

"Abandoned well" means any well whose use has been permanently discontinued. Any well shall be deemed abandoned which has been allowed to become unsealed, leaking, polluting, deteriorating in quality, uncontrollable, buried, or which is in such a state of disrepair that continued use for the purpose of obtaining ground water is impracticable or unsafe.

"Annular seal" means the grouted length of annular space between casing and the wall of the drilled or otherwise constructed hole.

"Annular space" means the space between the casing in a well and the wall of the hole or between two concentric strings of well casing.

"ANSI" means the American National Standards Institute.

"Aquifer" means a geologic formation that is sufficiently permeable to conduct ground water and to yield economically significant quantities of water to wells.

"Artesian well" means a well that is completed into an aquifer that is confined at greater-than-atmospheric pressure. Water in the well bore rises to a level above the level of the aquifer. An artesian well may or may not flow.

"ASTM" means the American Society for Testing and Materials.

"AWWA" means the American Water Works Association.

“Backflow preventor” means a device or means to prevent backflow of water into a well or potable water system.

"Basal aquifer" means an aquifer in which a body of ground water floats on a body of salt water in accordance with the buoyant density difference of the two bodies of water. As a general rule, each foot of saturated fresh ground water above mean sea level is supported by 40 feet of saturated fresh ground water below mean sea level.

"Caprock" means a geological formation or formations composed of terrigenous or marine sediments deposited over a formation or formations of volcanic origin. Caprock is substantially less permeable than volcanic formations and is often considered a confining material.

"Chairperson" means the chairperson of the Commission on Water Resource Management.

“Chemigation” means applying fertilizer or agricultural chemicals to land or crops through an irrigation system.

"Commission" means the Commission on Water Resource Management.

"Drainage Well” means a well primarily used for the disposal of rainfall runoff water. A drainage well could either be naturally dry or contain a naturally occurring water table.

“Dug well” means a shallow large diameter well or sump constructed by hand or with heavy equipment other than a drilling rig; generally used for stockwater, irrigation, or dust control.

"Enforcing agency" means a state or county governmental agency duly authorized to administer and enforce laws or rules pertaining to the construction, alteration, maintenance, operation, and closure of wells in Hawaii.

“Exploratory well” means a well drilled to obtain hydrologic data by geological analysis of the formations and aquifer testing. If conditions are adequate to develop ground water, an exploratory well can be converted to a production well. An exploratory well requires a well construction permit.

"FDA" means the United States Food and Drug Administration

"Geothermal well" means any well constructed for the location, exploration, monitoring, development, or injection of geothermal resources or the natural heat of the earth, the energy which may be extracted from the natural heat in whatever form found below the surface of the earth as defined by Chapter 182-1, HRS.

"Ground water" means any water found beneath the surface of the earth, whether in perched supply, dike confined, flowing, or percolating in underground channels or streams, under artesian pressure or not, or otherwise.

"Grout" means slurry used to seal any part of a well.

"Head" means the elevation in feet above mean sea level of the water level in a well or aquifer.

"High-level aquifer" means an aquifer in which a body of ground water is maintained at a higher level above mean sea level than that which can be explained by the buoyant density difference of ground water and salt water. Geologic structures, such as volcanic dikes or other poorly permeable formations, generally play a key role in the occurrence of high-level ground water.

"Injection well" means a well into which subsurface disposal of fluid or fluids occurs or is intended to occur by means of injection.

"Installation of pumps and pumping equipment" means the placement and preparation for operation of pumps and pumping equipment, including all construction involved in making entrance to the well, and establishing seals and repairs to existing installations.

“Modification” means any change to the physical dimensions of a well. Modification includes recasing, backfilling, redrilling or any change to increase or decrease the yield of a well. Modification does not include changes to the wellhead.

"Monitor well" means any cased permanent well drilled for the purpose of monitoring ground-water levels and salinity of ground water, or other flow properties of the aquifer. Cased

permanent wells for the purpose of monitoring contaminants other than chloride are Test Borings.

"Perched aquifer" means an aquifer that is formed by water confined on the top of an impervious to semi-pervious geologic layer of limited extent located between a large aquifer (basal or high-level) and the ground surface. The perched aquifer is separated from the primary aquifer by unsaturated material. Perched ground-water sources are generally small.

"Positive Displacement" means a procedure whereby grout is first introduced at the bottom of an interval and is pumped or forced with other applications of pressure upward through the interval, displacing fluids or air within the annulus.

"Potable water well" means any well that tap a fresh or brackish aquifer for drinking water use.

"Production well" means a well that forcibly withdraws ground water by pumping. A production well also includes artesian wells and tunnels.

"Public water system" means a system which provides water for human consumption, through pipes or other constructed conveyances if the system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least sixty days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system may be privately or publicly owned or operated. A public water system is a "community water system" or a "non-community water system". [Ref: Chapter 11-20-2, Hawaii Administrative Rules, "Potable Water Systems].

"Pump installation" means the installation, replacement, or repairs of any equipment utilized or intended for use in withdrawing or obtaining water from a water source.

"Pump installation contractor" means any person licensed in the State of Hawaii to install, replace, or repair pumps and pumping equipment.

"Pumps and pumping equipment" means all equipment and appurtenances utilized or intended for use in withdrawing or obtaining ground water. It includes seals, tanks, fittings, measuring devices, and controls.

"Repairs" means any replacement, change, or modification of any well, pump or pumping equipment. Customary or normal maintenance is not included in this definition.

"Salt water well" means a well that produces water with chloride content greater than 17,000 mg/L.

"Test boring" means any excavation or drilled hole whose purpose is the immediate determination of subsurface geologic, hydrologic, or contaminated conditions usually, but not always, in the unsaturated zone above the ground-water level. This definition includes borings for foundation, underground storage tanks, environmental monitoring under the purview of other government agencies and hazardous water remediation. A test boring is not intended for the purpose of conversion to a production well.

"USDA" means the United States Department of Agriculture.

"Water well" means any well, water development shaft, or tunnel being used, intended to be used, or capable of being used to withdraw ground water or any well, water development shaft, or tunnel to be constructed for the purpose of investigating, exploring, testing, or development of ground water.

"Water management area" means a geographic area which has been designated for management of the ground or surface-water resource therein, as provided in Chapter 13-171, "Designation and Regulation of Water Management Areas."

"Well" means any excavation or opening into the ground, or an artificial enlargement of a natural opening drilled, tunneled, dug, or otherwise constructed for the location, exploration, monitoring, development, injection, or recharge of ground water and by which ground water is drawn or is capable of being withdrawn or made to flow.

"Well construction" means the drilling, tunneling, digging or otherwise constructing a well for whatever purpose, including any alteration or repairs of an existing well, but excluding the installation of pumps and pumping equipment.

"Well driller" means any person licensed in the State of Hawaii to construct, modify, or repair wells.

Section 1.5 Exemptions from Unusual Conditions

The Standards presented herein are considered adequate for the protection of ground water and the prevention of ground-water waste from improper construction. If the Chairperson finds that compliance with any of the requirements of these Standards is impractical because of unusual conditions or circumstances the Chairperson may waive compliance with that requirement and prescribe alternative requirements. If the Chairperson determines that because of unusual conditions or circumstances these Standards do not provide adequate protection of the aquifer, then the Chairperson may also prescribe alternative or additional requirements.

Section 1.6 Well Drillers and Contractors

All work required in the construction, modification, or sealing of wells subject to these standards shall be performed by well drillers who have obtained a C-57 license-from the Hawaii Department of Commerce and Consumer Affairs, Division of Professional and Vocational Licensing.

All work required in the installation of pumps and pumping equipment shall be performed by well drillers with a C-57 license, pump installers with a C-57a license, or general contractors with an A license obtained from the Hawaii Department of Commerce and Consumer Affairs, Division of Professional and Vocational Licensing. To validate permits, licensed well drillers and/or pump installers must sign permits before any work is performed. The permit must be posted at the work site. Upon completion of work, well drillers and/or pump installers are required to sign well completion reports.

Section 1.7 Permits Required

In the State of Hawaii, work on water wells, production wells, exploratory wells and monitor wells requires a well construction permit from the Commission; work on injection wells requires a permit from the State Department of Health; and work on geothermal wells requires a permit from the Department of Land and Natural Resources, Engineering Division. Work on test borings does not require a permit, but all test borings should be sealed properly

before abandonment. The various permits required, the enforcing agency, and the applicable standards are summarized in Table 2, "Well Permits and Reports Required."

Applicants for well construction (includes modification), pump installation, and well sealing permits issued by the Commission, should check with the Commission or the Commission webpage **http://www.hawaii.gov/dlnr/cwrm/** for the latest updated form.

Any applicant for a well construction, pump installation or well sealing permit whose application is rejected or amended by the Chairperson may obtain a hearing before the Commission by filing within 30 days of the mailing of the notice of a rejected or amended application, a written petition requesting such a hearing. The hearing shall be conducted as provided in Chapter 13-167, "Rules of Practice and Procedure for the Commission on Water Resource Management."

The Commission may modify, suspend, or revoke a permit, after notice and hearing, on any of the following grounds:

1. Material misstatement or misrepresentation in the application for a permit.
2. Failure to comply with the provisions set forth in the permit.
3. Willful disregard or violation of any provision of this part or any rule adopted pursuant thereto.
4. Material change of circumstances or conditions existing at the time the permit was issued.

Section 1.8 Reports Required

Reports relating to construction, modification, and abandonment of water wells and monitor wells are required to be filed by the permittee with the Commission as provided in the appropriate sections of these Standards.

Persons filing a well completion report, well abandonment/sealing report, or pumping test record required by the Commission should check with the Commission for the latest updated forms or may refer to its web page at **http://www.hawaii.gov/dlnr/cwrm/.**

Section 1.9 Exclusions

The requirements in Part 2, "Well Construction" of these Standards do not apply to water development tunnels, dug wells and shafts. The Chairperson shall consider the designs of these water development structures on a case-by-case basis.

Table 2. Well Permits and Reports Required

Well Type	Proposed Activity	Permit Requirements			Applicable Well Standards
		Permit	Report	Enforcing Agency	
Water Well (fresh, brackish, & salt water)	Drill new well. Modify existing well. Redrill existing well. Deepen existing well. Abandon/seal existing well.	Well Construction	Well completion report. Well abandonment/sealing report.	Commission	These Standards
	Install new pump. Modify existing pump to a larger capacity. Replace existing pump with a larger pump.	Pump Installation	Well completion report.	Commission	These Standards
Monitor Well	Drill new well or modify an existing well. Abandon/seal existing well.	Well Construction	Well completion report.	Commission	These Standards
Injection Well	Construct; Operate; Modify; Abandon/Seal.	Underground Injection Control (UIC)	Refer to Chap. 11-23, HAR	State Department of Health	Chapter 11-23, HAR
Geothermal Well	Drill; Modify; Modify use; Abandon/seal.	Geothermal	Refer to Chap. 13-183, HAR	State Department of Land & Natural Resources	Chapter 13-183, HAR
Test Boring	Excavate/drill. Abandon/seal.	None	None	None	None
Drainage wells	Construct; Operate; Modify; Abandon/Seal.	Underground Injection Control (UIC)	Refer to Chap. 11-23, HAR	State Department of Health	Chapter 11-23, HAR

Note: (1) New water wells to be used to supply a public water system must meet the requirements of Chapter 11-20, entitled, "Rules Relating to Potable Water Systems" of the State Department of Health.
(2) Test borings related to UIC and/or environmental monitoring or remediation are subject to the State Department of Health.

HAR = Hawaii Administrative Rule.

Part 2.

WELL CONSTRUCTION

Part 2.
WELL CONSTRUCTION

Section 2.1 Well Construction Permits

No well, except injection, drainage, geothermal, and temporary test boring wells shall be constructed, modified, repaired, or abandoned and sealed without a well construction permit approved by the Chairperson. Injection wells, drainage wells and geothermal wells require permits from other state agencies (Table 2). Temporary test borings do not require a well construction permit. Permanent test borings for hydrologic monitoring of water levels and/or water quality are considered monitor wells, which require a well construction permit.

Applications for a well construction permit shall be made on the most recent forms provided by the Commission. The forms are available at the Commission office or at **www.hawaii.gov/dlnr/cwrm/.** A well construction permit may be approved and issued if the proposed construction complies with all applicable laws, rules, and standards. In some cases, when the knowledge of the hydrogeology of an area is limited, an application without proposed construction will also be approved. In either case, final construction of the well must conform to these standards. The well construction permit shall be prominently displayed at the site of the well at all times until the well construction is completed. Every well construction permit shall require the well driller to file a well completion report.

Every permit for construction or modification of a water production well shall require a pumping test in accordance to these standards. Measurements of time, pumping rate, drawdown, chloride content, well recovery data, and temperature shall be recorded and reported as required in these Standards.

The holder of a well construction permit, with the approval of the Chairperson, may change the location of the well before or after start of construction. A written request to change the location shall state the location, proposed depth, method of construction, size, and expected capacity of the new well. The request to change the location shall also state the manner of sealing or plugging the abandoned well if applicable. The Chairperson may

consult with the Department of Health for compliance with their rules and standards concerning, among other things, the appropriateness of the location of the well.

Section 2.2 Basal Well Depth

Except for salt-water wells, any well constructed in basal aquifers for the purpose of nonpotable or potable water withdrawal shall be initially designed and pump tested at a depth below sea level not exceeding one-fourth of the theoretical thickness (41 times the head) of the basal ground-water body, unless authorized by the Chairperson. Upon request by the permittee and submission of the supporting data and analysis, the Chairperson may allow deepening and subsequent testing of such wells to a depth below sea level not exceeding one-half of the theoretical thickness of the basal ground-water body.

Section 2.11 (a) of these standards defers the elevation survey for non-public water supply wells of less than 70 gpm installed capacity. If the permittee chooses to defer the elevation survey the exact elevation of the ground at the well and water level will be unknown. The well shall still be optimized according to an estimated water level elevation. The Chairperson shall reserve the right to revise the permittee's water-level elevation estimate. If the permittee contests the Chairperson's estimated water level then the permittee shall perform an elevation survey.

Section 2.3 Well Location

a) **Distance from Sources of Pollution**

New wells shall be sited the maximum distance possible from sources of pollution. Some possible pollution sources include wastewater lines, cesspools, septic tanks, wastewater leaching fields, landfills, chemical storage and injection wells.

(b) **Gradients (slopes)**

Where possible, wells should be located hydraulically up-gradient (normally on a higher slope) from potential sources of pollution. Consideration should also be given to the fact that pumping a well may cause a localized reversal of the existing ground-water gradient due to drawdown of the ground-water table.

(c) **Flood and Drainage Areas**

When avoidable, wells should not be located in flood zones. Potable water wells located in flood and drainage areas shall have well casing terminated 2 feet above the 100-year level of flooding, as shown on the latest FEMA (Federal Emergency Management Agency) map and be properly designed to avoid potential contamination of the aquifer from flood waters. If necessary, the immediate area around a potable water well should be built up so that drainage moves away from the well.

(d) **Accessibility**

All wells shall be located an adequate distance from buildings and other structures to allow permanent access for well modification, maintenance, repair, and abandonment/sealing.

Section 2.4 Well Casing

(a) **General**

Wells which are to be used for water supply or monitoring shall be constructed with well casing adequate to maintain the structural integrity and intended use of the well and to maintain the natural pre-existing state of protection of the ground-water aquifer from pollution or contamination. Well casing shall be strong enough to resist the forces imposed upon it during and after installation. Casing standards apply only to permanent well casing and not to casing installed temporarily for construction purposes.

(b) **Wall Thickness of Casing**

The wall thickness of well casing shall be selected in accordance with good design practices applied with due consideration to conditions at the site of the well and shall be sufficient to withstand anticipated formation and hydrostatic pressures imposed on the casing during its installation, grouting, well development, and use. The minimum wall thickness of carbon-steel casings in wells shall conform to Table 3 and the AWWA standards for water wells (ANSI/AWWA A100-97), as may be amended.

The wall thickness for steel casing in public water supply wells shall be as listed in Table 4 and "Water System Standards," State of Hawaii, 2002, p. 306-3, as may be amended.

Table 3. Minimum Steel Casing Wall Thickness for Non- Public Water Supply Wells

Depth of Casing (ft)	MINIMUM WALL THICKNESS (in fractions of an inch)									
	Nominal Casing Diameter in inches:									
	8	10	12	14	16	18	20	22	24	30
0-100	1/4	1/4	1/4	1/4	1/4	1/4	1/4	5/16	5/16	5/16
100-200	1/4	1/4	1/4	1/4	1/4	1/4	1/4	5/16	5/16	5/16
200-300	1/4	1/4	1/4	1/4	1/4	5/16	5/16	5/16	5/16	3/8
300-400	1/4	1/4	1/4	1/4	5/16	5/16	5/16	5/16	3/8	3/8
400-600	1/4	1/4	1/4	1/4	5/16	5/16	5/16	3/8	3/8	7/16
600-800	1/4	1/4	1/4	5/16	5/16	5/16	3/8	3/8	3/8	7/16
800-1000	1/4	1/4	1/4	5/16	5/16	5/16	3/8	7/16	7/16	1/2
1000-1500	1/4	5/16	5/16	5/16	3/8	3/8	3/8	7/16		
1500-2000	1/4	5/16	5/16	5/16	3/8	3/8	7/16	7/16		

Reference: ANSI/AWWA A100-97

Table 4. Minimum Wall Thickness for Public Water Supply Wells

Nominal Diameter (inches)	Wall Thickness (inches) decimal
2	0.154
2-1/2	0.203
3	0.216
3-1/2	0.226
4	0.237
6-8	0.280
10	0.322
12	0.375
14	0.375
16	0.375
18	0.375
20	0.375
22	0.500
24	0.500
26	0.500

Reference: 2002 County Water System Standards

(c) Minimum length of solid casing

All wells drilled to non-artesian (non-confined) basal, high-level, caprock or perched aquifers shall have a minimum length of solid casing equal to 90% of the depth to the water level of the aquifer to be developed. Wells drilled to artesian (confined) aquifers shall be cased so that leakage does not occur into overlying or underlying formations. In general, no well may be allowed to develop water from more than one aquifer. The minimum length of solid casing for salt-water wells shall be through the entire fresh and brackish water portion of the lens. The Chairperson may approve deviations from casing length requirements if the permittee can show that the aquifer is adequately protected.

(d) **Casing Materials**

(1) Steel. All steel casing shall be new and conform to one of the manufacturing standards listed in Table 5 and in the standards of AWWA publication ANSI/AWWA A100-97, as may be amended. The physical properties of the steel shall conform to ASTM A-242, ASTM A53, Type E or S, Grade B, or approved equal. The well casing shall be manufactured in accordance with applicable sections of ASTM A139, as may be amended.

Table 5. Water Well Casing Materials

Manufacturing Standards for Carbon-Steel Well Casing:
ANSI/AWWA C200
API Spec. 5L
ASTM A53
ASTM A139
ASTM A606

(2) Stainless Steel. Stainless steel casing for wells shall meet the provisions of ASTM A409, "Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service," and any revision.

(3) Plastic and Thermoset Plastic (Fiberglass). Except as determined by the Chairperson on a case-by-case basis, plastic casing shall not be used in wells where well

depth exceeds 200 feet or where drilling tools are contemplated to be used to re-enter the well following installation of the casing.

Thermoplastic well casing shall meet the requirements of ASTM F480, "Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80", and any revision. The following specifications shall apply to thermoplastic well casing.

ABS Pipe. ASTM D1527, "Standard Specifications for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80."
PVC Pipe. ASTM D1785, "Standard Specifications for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120."
Pressure-Rated PVC Pipe. ASTM D2241, "Standard Specifications for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)."

Thermoset casing material shall meet the following standards, as applicable, and any revision:

Filament Wound Resin Pipe. ASTM D2996, "Standard Specification for Filament Wound Reinforced Thermosetting Resin Pipe."
Centrifugally Cast Resin Pipe. ASTM D2997, "Standard Specification for Centrifugally Cast Reinforced Thermosetting Resin Pipe."
Reinforced Plastic Mortar Pressure Pipe. ASTM D3517, Standard Specification for Reinforced Plastic Mortar Pressure Pipe."
Glass Fiber Reinforced Resin Pressure Pipe. AWWA C950, "AWWA Standard for Glass-Fiber-Reinforced Thermosetting-Resin Pressure Pipe."

Plastic casing or screen shall not be subjected to excessive stress during installation and shall not be driven into place. Care shall be taken to insure that plastic casing and joints are not subjected to excessive heat or pressure from grouting.

(e) **Casing Joints**

Steel casing may be joined by welds, threads, threaded couplings, or any combination thereof. Welding shall be accomplished in accordance with the standards of the American Welding Society or the most recent revision of the American Society of

Mechanical Engineers Boiler Construction Code. Casing joints shall be of the types listed in Table 6 and in AWWA publication ANSI/AWWA A100-97, as may be amended.

Table 6. Well Casing Joint Standards

Casing Material	Type of Joint	Standard
Steel Plastic	Welded or threaded Threaded solvent-welded or other mechanical joint	AWWA C206 ASTM F480

Plastic casing may be joined by solvent welding or mechanically joined by threads or other means. Solvent cement used for solvent welding shall meet specifications for the type of plastic casing used and shall be applied in accordance with solvent and casing manufacturer instructions.

The following standards for solvent cements and joints for PVC casing shall be met, including any revision:

> ASTM D2564, "Standard Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings."
>
> ASTM D2855, "Standard Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings."

Section 2.5 Rock or Gravel Packing the Annular Space

Rock or gravel packing shall consist of locally produced crushed basaltic aggregate, or preferably, commercially available rounded gravel. Such rock or gravel packing material shall be obtained from clean, non-contaminated sources. The aggregate size should be larger than the slot or louver size of the casing. Handling and storage of the rock or gravel packing material at the well site shall be such that it remains free of contaminants and debris until placed in the annular space and shall be disinfected by drenching with a 100 mg/L chlorine solution, see Section 2-8(a), just before placement in the well.

Section 2.6 Grouting the Annular Space

(a) **General**

The reason that the annular space of all wells must be sealed with grout from the ground surface to a minimum specified depth is to prevent the downward passage of poor quality water, pollutants, or contaminants from surface sources and subsurface sources in the unsaturated zone above the aquifer. Other reasons for grouting the annular space are to protect the casing and stabilize the wall of the drilled hole, and to prevent vertical movement of water along casing in a saturated zone (e.g. salt-water and artesian wells). In general, only one aquifer may be exploited unless approved by the Chairperson.

(b) **Conductor Casing**

Conductor casing (often called conductor pipe) is sometimes installed on a temporary basis to stabilize the near-surface part of the drilled hole during well construction. Conductor casing that is permanent and reached the minimum depths specified in part 2.6 (c) must be grouted as permanent casing as described in part 2.6. Conductor casings installed without a grouted annular space must be removed in a manner that will permit complete grouting of the annular space between the permanent well casing and drilled hole to the ground surface.

(c) **Minimum Depth of Grouted Annular Space**

To prevent surface contamination, the annular space of all cased non-artesian wells must be sealed with grout from the ground surface to a minimum depth of 500 feet or 70% of the vertical distance between the ground surface and the top of the aquifer selected for exploration, long-term monitoring, or development, whichever depth is less. Wells drilled to artesian (confined) aquifers shall be grouted and cased so that leakage does not occur into overlying or underlying formations. Salt-water wells shall be grouted through the entire fresh and brackish portion of the basal lens. Perched aquifers above the target aquifer must be cased and grouted off.

(d) **Minimum Thickness of Grouted Annular Space**

The annular space of wells to be grouted must be a minimum of one and one half inches all around the maximum dimension of the casing if the grout is placed by positive displacement. If positive displacement is not used the minimum annular space is two

inches for all wells except public water supply wells. Public water supply wells are required to have a three inch annulus if the positive displacement technique is not used.

(e) **Grouting Materials for Annular Sealing**

Drill cuttings or drilling mud shall not be used for any part of the grout material. Neat cement used to grout wells shall conform to the requirements of ASTM C150 for Portland cement, Type I. Special cement-setting accelerators and retardants and other additives may be used, if necessary. Such additives shall meet the requirements of ASTM C494, "Standard Specifications for Chemical Admixtures for Concrete", and any revision.

(1) Sand-Cement Slurry. Sand-cement for grouting shall be mixed at a ratio of not more than one part sand to one part cement, by weight, and not more than six gallons of potable water per sack of cement.

(2) Neat Cement Grout. Neat cement for grouting shall be mixed at a ratio of one 94-pound sack of Portland cement to not more than six gallons of potable water.

(3) Cement-Bentonite: a slurry of cement, bentonite and water. The amount of bentonite added shall not exceed 8% bentonite per dry weight of cement (7.5 pounds of bentonite per 94 pound sack of cement). The volume of additional water used in preparing these slurries is limited to three quarters (0.75) of a gallon per 94 pound sack of cement for each 1% of bentonite added.

(4) Other Grouts. The Chairperson on a case-by-case basis may approve other grouting materials.

(f) **Placement of the Annular Grout**

The annular space shall be grouted as soon as possible after installation of the casing. Grout can be placed by positive displacement, by pumping or gravity flowing through a grout (tremie) pipe or by freefall displacement in a shallow well. The driller shall sound annulus to check for settling of the grout within 24 hours of placement. Placing the grout in the annular space may be done in stages with time allowed for the grout to set between stages so as to prevent distortion or collapse of the casing by heat or pressure. Grouting the annular space may be accomplished by freefall placement if the annular space to be grouted is no deeper than 20 feet below ground surface and is in the unsaturated zone above the ground-water level.

Section 2.7 Well Development

Well development consists of methods to remove drill cuttings or other material causing low permeability from the formation in open hole or slotted casing. Development or redevelopment of a well shall be performed with care so as to prevent damage to the well and casing. The well should be developed prior to the test pumping to maximize the flow of ground water into the well bore.

Water, sediment, or waste removed by well development or re-development operations shall be disposed of in accordance with applicable federal, state, and county requirements. The enforcing agency shall be contacted concerning the proper disposal of waste from development operations.

Section 2.8 Well Disinfection

(a) **General**

All non-artesian water supply wells for potable use or tapping aquifers having a chloride concentration of less than 250 milligrams per liter shall be disinfected with the proper amount of chlorine following the completion of any work, including pump installation and repair and well abandonment. The purpose of disinfection is to minimize the introduction of pathogens into the aquifer.

All materials installed in wells shall be thoroughly and carefully cleaned and disinfected with a 100 mg/L chlorine solution to ensure that all harmful or disease carrying organisms are eliminated.

A 100 mg/L chlorine solution can be prepared by mixing 0.7 quart of common household bleach (containing 5% available chlorine) with 100 gallons of water or by mixing 2¼ ounces of dry calcium hypochlorite (commonly used in swimming pools, containing 70% available chlorine) with 100 gallons of water.

(b) **Disinfection of Aquifer Section**

The aquifer section of all wells shall be disinfected by using chlorine. Depending upon the situation, the chlorine shall be placed and thoroughly mixed in the aquifer by pouring directly, using a bailer, using the rotary drill pipe, or using the test pump, as appropriate. Mixing shall be accomplished by running the bailer or drill pipe up and down

the aquifer three or four times, or gently pump surging, as the case may be. The chlorine solution shall be allowed to remain in the well overnight or at least eight hours.

Sufficient chlorine shall be placed in the well to obtain a chlorine concentration of at least 100 mg/L when mixed with the volume of water in the drilled hole. The amount of common household bleach or dry calcium hypochlorite to be used for well disinfection depends upon the diameter of the drilled hole and the depth of aquifer penetration (Table 7).

Table 7. Guideline Amounts of Chlorine Necessary to Disinfect the Borehole

Drilled Hole Diameter (inches)	Volume of water in 100 ft of column (gallons)	Cups of liquid household bleach to use in 100 ft column (1)	Cups of dry calcium hypochlorite to use in 100 ft column (2)
4	65	3	1/4
6	147	5	1/2
8	261	9	3/4
10	408	14	1
12	587	19	1 1/2
14	800	27	2 1/2
16	1044	36	3
18	1322	45	3 3/4
20	1632	56	4
24	2350	74	6

(1) The volume of liquid bleach, based on 5% available chlorine, has been rounded up to the next full cup.

(2) The volume of dry powder, based on 70% available chlorine, has been rounded up to the next 1/4 cup.

2.9 Well Testing

(a) Introduction

Well testing is required when new wells are drilled or when existing wells are modified and have not been previously tested in accordance with the provisions of these Standards. Well testing normally consists of a short step-drawdown test followed by a long-term constant-rate test. Well testing is not mandatory for monitor wells. The purpose of well testing in the prescribed manner is to determine the well efficiency and to gain

information on the aquifer. Water from test pumping shall be disposed of in accordance with applicable federal, state, and county requirements. Testing procedures for free-flowing artesian wells with no pump shall be determined on a case-by-case basis with the concurrence of the Chairperson. Test pumping is not necessary for salt-water wells unless specified by the Chairperson.

(b) Step-Drawdown Tests (Well Efficiency Test)

Step-drawdown tests are required to establish the efficiency of the well and to provide preliminary information on the yield, drawdown, and salinity (chloride content) of the well. Step-drawdown tests are not required for wells of less than 70 gpm proposed capacity. However, a step-drawdown test must be conducted for all public water supply wells. The water level in the pumped well should be measured at minimum intervals according to forms provided by the Commission. The step-drawdown test shall consist of pumping the well at progressively increasing fractions of the maximum discharge capacity proposed by the permittee or determined during well development. The minimum length of time for each discharge rate shall be one-half hour and the minimum number of discharge rates shall be three (3) and shall be sufficient to induce observable changes in pumping water levels from one pumping rate to the next. Pumping should be continuous throughout the entire step-drawdown test.

If the permittee is unable to perform a step-drawdown test according to these standards then the Chairperson may not accept the test results or in lieu of the substandard step-drawdown test the Chairperson may require a modified and more comprehensive constant rate long-term test.

(c) Constant-Rate Tests (Aquifer Test)

Constant rate tests are intended to determine the hydraulic properties of an aquifer. The test helps identify hydrologic boundaries such as dikes or streams. Constant-rate tests also help quantify salinity trends in basal aquifers. The constant-rate test can be important in determining and/or predicting interference with neighboring wells and streams.

The pumping rate for the constant-rate test should be determined from the results of the step-drawdown test. The constant-rate test shall not commence until the water level in the pumped well has fully recovered from the step-drawdown test. The constant pumping

rate must be equal to or greater than the final installed pump capacity (a 10% variation shall be allowed). Constant-rate tests shall be pumped continuously for a minimum period of time, as shown in Table 8. The Chairperson may require longer constant rate tests for wells near streams or for wells in high-level aquifers. As soon as possible after the termination of the constant rate test the recovering water level in the production well should be measured at intervals specified in the forms provided by the Commission. If possible, water levels should be measured until full recovery.

The water discharged from a well during constant-rate tests shall be transported to a distance sufficient to prevent the pumped water from reaching the ground-water table and affecting the test results. If possible, observation wells shall be used during the constant rate test.

Table 8. Minimum Test Period for Constant-Rate Tests

Proposed Use of Well	Proposed Capacity (gpm)	Minimum Test Period (hours)
Non-Public Water Supply	0 - 50	0
	51 - 100	8
	101 - 300	24
	301 - 700	48
	701 – 1000	72
	1001 +	96
Public Water Supply		96

(d) **Accuracy of Measurements**

The rate of pumping shall be recorded in gallons per minute (gpm). The depth to water shall be measured as accurately as possible, but in no case less accurate than to the nearest one-tenth of a foot. Time shall be measured as accurately as possible, but in no case less accurate than to the nearest minute.

(e) **Minimum Frequency of Measurements**

For constant-rate tests, the depth to water in the pumped well should be measured at intervals according to pump test forms provided by the Commission.

(f) **Pumping Test Records and Reports**

The permittee shall file with the Commission the following:

(1) Step-Drawdown Pumping Test Record (on forms provided by the Commission or copy thereof).

(2) Constant-Rate Pumping Test Record (on forms provided by the Commission or copy thereof).

Section 2.10 Well Completion

(a) **General**

Wells must be adequately protected at all times during and after construction to prevent the entrance of surface water runoff, pollutants, and contaminants; unauthorized access; and damage to the well. All non-producing wells must be completed with the casing extended a minimum of two (2) feet above the ground surface and capped in a manner that will prevent unauthorized entry or any pollutants from entering the well except where site conditions, such as vehicular traffic, will not allow. Such wells shall conform to the following:

(1) Lockable Cover. The top of the well casing shall be cut smooth and straight with a lockable cover to prevent unauthorized access and prevent a hazard to humans and animals. The cover shall be weather and vermin proof.

(2) Casing Cap. Alternatively, the top of the well casing may be capped with a welded steel plate or solvent-welded plastic cap (for plastic casings) fitted with a 1½-inch minimum diameter threaded cap or plug which cannot be easily opened with small or light tools. Openings or passages for probing, venting, cables, or discharge tubing shall be protected against entry of surface water, pollutants, contaminants, and vermin.

(3) Flooding. The top of the well casing should terminate above ground surface at least 2 feet above the 100 year flood elevation, except where site conditions, such as vehicular traffic, will not allow.

(4) Concrete Base. Unless otherwise approved by the Chairperson, a concrete base shall be constructed around the well casing at ground surface in contact with the annular grout seal. The base shall be at least four inches thick and shall slope slightly to drain away from the well casing. The base shall extend at least two feet laterally in all directions from the outside of the well casing. The concrete base shall be free of cracks,

voids, and other significant defects likely to prevent water tightness. Contacts between the base and the annular grout seal, and the base and the well casing must be water tight.

(5) Well Pits or Vaults. The use of well pits, vaults, or equivalent features to house the top of a potable water well below ground surface should be avoided, because of their susceptibility to the entrance of surface water runoff and pollutants. Well pits or vaults shall only be used with approval of the Chairperson.

(6) Protection from Vehicles. Protective steel posts, or the equivalent, shall be installed around a well where it is terminated above ground surface in areas of vehicular traffic. The posts shall be easily seen and shall protect the well from vehicular impact.

(7) Paint and Markings. The well shall be permanently marked by an engraved plate, engraved label or painted label showing the well's assigned State well number and the casing painted so as to be easily visible, located, and identified in the field.

(8) Artesian Wells. Flowing wells shall be equipped so that the discharge can be controlled or stopped at all times. It is the responsibility of the well owner to ensure this equipment is maintained and operational.

(b) **Well Completion Report and Records**

Within 60 days after the completion of the construction, modification, or repair of a well the permittee shall file with the Commission, as appropriate, the following:

1. For all wells, a well construction report (Part I of Well Completion Report form provided by the Commission).
2. For all permanent pumps, a pump installation report (Part II of Well Completion Report form provided by the Commission).

Section 2.11 Elevation Survey and GPS Location

(a) **Elevation Survey**

An accurate elevation benchmark shall be clearly established on the concrete base by a licensed surveyor. Documentation and surveyor's stamp shall be submitted. The surveyor's documentation shall identify the original elevation benchmark that was used to establish the well benchmark. The required establishment of elevation benchmarks for non-public water supply wells of less than 70 gpm installed pumping capacity is deferred

until the Chairperson deems it necessary before or after well construction or pump installation. Salt water wells do not require an elevation survey.

(b) GPS Location

The well shall be located with a GPS receiver. The GPS coordinates shall be reported in the NAD83 datum.

Part 3.

WELL ABANDONMENT/SEALING

Part 3.
WELL ABANDONMENT/SEALING

Section 3.1 General

All wells and test borings as defined in these Standards must be properly abandoned and permanently sealed to protect the ground-water resources of the State of Hawaii from contamination and waste and to protect public health and safety, whenever:

1) The well has served its purpose, or
2) The use of the well has been permanently discontinued, or
3) The well is not being properly maintained, or
4) The physical condition of the well is causing a waste of ground water or is impairing or threatens to impair the quality of the ground-water resources, or
5) The well is in such a state of disrepair that its continued use is impractical or it is a hazard to public health or safety

The objective of permanently sealing a well or test boring before abandonment is to restore the geological and hydrological conditions that existed before the well or test boring was constructed, taking into account any changes which may have occurred since the time of construction. (For example, a well that may have originally produced potable water, but which now produces nonpotable water.) The well casing must be removed if such removal is necessary to accomplish the objective. However, if the casing cannot be readily removed, the blank casing above the aquifer must be perforated to allow grouting of the annular space. Permanent sealing of a well shall be accomplished by grouting with a tremie pipe from bottom to top. The Chairperson shall review the sealing plan for shafts and pits on a case-by-case basis.

Abandonment and permanent sealing of a well requires a permit from the Commission. A permit is not required for abandonment/sealing of test borings. A licensed well driller with a C-57 license shall perform all well abandonment and sealing. A detailed record of the abandonment and sealing of all wells must be maintained by the well driller

for future reference and demonstration that the well was properly sealed. A well abandonment/sealing report (forms available at the Commission office or at **http://www.hawaii.gov/dlnr/cwrm/)** must be filed with the Commission within 60 days after completion of the work.

The Commission shall be notified in accordance with permit conditions before work on abandonment and sealing begins.

Section 3.2 Responsibility for Abandonment/Sealing

The responsibility and cost for voluntary or involuntary abandonment/sealing of a well rests with the well owner and/or operator. The owner and/or operator of a well to be abandoned and sealed shall not commence with the required remedial work until an application has been made and a well construction permit has been approved by the Chairperson.

Section 3.3 Initiation of Abandonment/Sealing

(a) **Initiated by Well Owner or Operator**

The owner and/or operator of a well may voluntarily seek abandonment/ sealing of a well by first causing an application to be made for a well construction permit on forms provided by the Commission (forms available at the Commission office or at **http://www.hawaii.gov/dlnr/cwrm/).** The application shall include the reason for abandonment and a description of the proposed procedure and work to be performed.

(b) **Initiated by Commission**

The Chairperson may declare that a water well is abandoned and shall notify the owner and/or operator that it must be permanently sealed if it finds that one or more of the five criteria in section 3.1 have been met.

Section 3.4 Grouting Materials for Permanent Sealing

Grouting materials acceptable for use to permanently seal wells and test borings are neat cement, sand-cement slurry, concrete, cement bentonite or bentonite pellets. The materials selected depend on field conditions and must be approved by the Chairperson

prior to sealing. After grouting, all wells must be sounded to determine if the grout has settled.

Cement used for neat cement, concrete, cement-bentonite and sand-cement slurry shall conform to the requirements of ASTM C150 for Portland cement, Type I.

(1) Sand-Cement Slurry. Sand-cement for grouting shall be mixed at a ratio of not more than one part sand to one part cement, by weight, and not more than six gallons of water per sack of cement. Clean well sorted sand shall be used.

(2) Neat Cement Grout. Neat cement shall be mixed at a ratio of one 94-pound sack of Portland cement to not more than six gallons of potable water.

(3) Concrete. Concrete shall contain 5.3 sacks of ASTM C150 type 2 Portland cement per cubic yard of concrete and a maximum of 7 gallons of water per 94-pound sack of cement. The aggregate shall consist of 47 percent sand and 53 percent coarse aggregate conforming to ASTM C33.

(4) Cement-Bentonite: a slurry of cement, bentonite and water. The amount of bentonite added shall not exceed 8% bentonite per dry weight of cement (7.5 pounds of bentonite per 94 pound sack of cement). The volume of additional water used in preparing these slurries is limited to three quarters (0.75) of a gallon per 94 pound sack of cement for each 1% of bentonite added

(5) Bentonite grout. Bentonite grout shall consist of a high-solids bentonite grout and water mixture with a minimum of twenty percent solids, mixed and placed in accordance with the manufacturer's written instructions. Bentonite shall not be used in brackish or salt water wells. Bentonite has a higher tendency to settle and may not be appropriate for some conditions.

Section 3.5 Preliminary Work

Wells that are to be abandoned and permanently sealed shall be investigated by studying existing well records and verifying the physical conditions and as-built dimensions of the well. Such wells shall be sounded with an appropriate tool to check and clear the well of any obstructions, undesirable debris or cave-in material, oil from an oil-lubricated pump, or other pollutants that could interfere with a satisfactory well seal.

Depending upon the situation, such wells may also be probed with a magnet, video camera, caliper log, or other well tools to determine depths, dimensions, and conditions of the well casing and artesian leakage.

All equipment, loose casing, foreign materials, and obstructions that may interfere with sealing operations must be removed from the well, if possible. Any casing and conductor pipe not removed from the well must be cut off at least two feet below the ground surface and the remaining hole filled with material appropriate to the site or grouted with cement-based material, if in hard rock.

The Chairperson shall be notified as soon as possible if pollutants or contaminants are known, discovered, or suspected to be present in the to-be-abandoned and sealed well. If a well is found to be contaminated the Chairperson may require more stringent sealing procedures. If a well pump is found to contain mercury seals, then the owner shall be required to mitigate any possible contamination.

Section 3.6 Sealing the Aquifer Section of a Well

(a) **Open Hole Section**

After the preliminary work of abandonment and sealing has been completed, the well must be grouted as soon as possible from bottom to top beginning with the open hole section, if any, of the well.

The open hole section of the well shall be grouted with the appropriate grouting material by pumping or gravity-flowing it through a grout (tremie) pipe. The bottom of the grout pipe shall be withdrawn in stages as the open hole becomes filled, but shall extend into the slurry column while the grout is being placed so as to prevent inclusion of cave-in or foreign material, bridging, dilution or separation of grout materials.

If an interval of open hole occurs in cavernous or highly fractured formation that causes excessive loss of grout, crushed aggregate (conforming to ASTM 10M) or concrete sand (conforming to ASTM C-33) may be used to fill such intervals of loss, before continuing to grout. The Chairperson may approve alternative designs if the applicant can show that the well will be adequately sealed.

(b) **Perforated Casing Section**

After the open hole section of the well has been grouted, the perforated casing section of the well shall next be sealed with neat cement placed from bottom to top with a tremie pipe in a manner conforming to the grouting of the open hole section

Section 3.7 Sealing the Solid Casing Section of a Well

(a) **Properly Grouted Wells**

The solid casing section of a well with a properly grouted annular space may be sealed with sand-cement slurry in one continuous operation from bottom to the ground surface.

(b) **Improperly Grouted Wells**

If a well has no record of having a properly grouted annular space and poses a significant threat of surface contamination of an underlying potable aquifer or waste of artesian ground water, the solid casing must be perforated before grouting begins. The solid casing section shall be sealed with neat cement in one continuous operation from bottom to ground surface using a tremie pipe in a manner conforming to these Standards. If an interval of the solid casing section cannot be filled after placement of a reasonable amount of neat cement slurry, sand-cement slurry conforming to the standards for permanent sealing may be used to fill such interval before continuing the sealing of the blank casing section with neat cement.

Section 3.8 Special Provisions for Artesian Wells

(a) **General**

Many artesian wells in Hawaii are old and may have deteriorated and leaking casings. Consequently, such artesian wells must be abandoned and permanently sealed. Artesian wells usually require a very thorough investigation of the physical condition of the well and any possible artesian flow or leakage in the well before satisfactory grouting can be accomplished.

(b) **Preliminary Work**

In addition to the preliminary work required for wells in general and described elsewhere in these Standards, artesian wells to be abandoned must be investigated to determine the occurrence, depths and magnitude of any ground-water leakage from the aquifer upward into overlying strata through corroded or improperly grouted well casing. A video or caliper log of the well may be required in such cases, especially if leakage may interfere with proper sealing of the well. An assessment of well conditions and proposed sealing procedures shall be discussed with the Commission staff before sealing operations are started. The assessment may include a survey of water levels in adjacent wells, a video log, or a vertical flow meter log to confirm whether or not the artesian well is leaking.

(c) **Sealing Procedures**

Before placement of grout to permanently seal an artesian well, any flow or leakage in the well must be stopped or reduced so that the confining strata above the artesian aquifer can be effectively sealed with neat cement or sand-cement slurry.

If the artesian flow is occurring from the open hole section of the well, placement of large rounded cobbles followed by lesser size cobbles and crushed aggregate, or placement of specially formed concrete cylinders may significantly reduce flow in the well. Packers with grout pipe extending below the packer may also be effective in sealing the open hole section.

Once flow from the artesian aquifer has been stopped or significantly reduced, the solid casing may have to be perforated (see Sec. 3.7.b) before grouting the remaining part of the artesian well with sand-cement slurry. If artesian leakage continues to occur, placing or pumping the sand-cement slurry at a high rate through a grout pipe may be required to successfully complete the sealing operation.

If the solid casing is intact and there is no flow in the annular space, the flow inside the casing may be stopped by installing a riser pipe before sealing an artesian well from bottom to top with sand-cement slurry.

Section 3.9 Well Abandonment/Sealing Report

Within 60 days after completion of the required work, permittee shall file with the Commission a well abandonment/sealing report containing the owner's and operator's name and address, the water use permit number, if any, the reason for abandonment/sealing, and a complete description of the work performed.

Part 4.

PUMP INSTALLATION

Part 4.
PUMP INSTALLATION

Section 4.1 Pump Installation Permits

(a) **General**

No pump or pumping equipment shall be installed in a well without an appropriate permit, unless otherwise provided for in this section (applications are available at the Commission office or at **http://www.hawaii.gov/dlnr/cwrm/).** A pump installation permit shall be issued only if the proposed construction complies with all applicable laws, rules, and standards. The permit shall be prominently displayed at the site of the well at all times until the pump installation is completed.

Within Commission-designated water management areas (or aquifer systems), a pump installation permit to install a new pump or replace, modify, or repair an existing pump in a well may be approved by the Chairperson if the well user or owner holds an approved water use permit for such a well. If no water use permit has been obtained, the Commission must first act on the application for a water use permit.

The replacement, modification, or repair of an existing permanent pump does not require a pump installation permit if such work does not exceed the existing or permitted pump capacity. The well owner/operator is still required to submit a completed pump installation report (Part II of Well Completion Report form available at the Commission office or at **http://www.hawaii.gov/dlnr/cwrm/).** Every pump installation permit shall require the pump installation contractor to file a well completion report as required in these Standards. Every pump installation permit for a new or existing well without a pumping test meeting these Standards may require that a pumping test under these Standards be conducted.

(b) **Emergencies**

When emergency installation, alteration, repair, or replacement of a pump or pumping equipment which normally requires a permit is required to prevent or minimize

loss of life, risk to public health and safety, or damage to property, a well owner may proceed with the emergency work without a permit.

As soon as possible after initiation of any emergency work, the well owner doing the work shall notify the Chairperson and describe the nature and circumstances of the remedial work. Within 60 days of notification to the Chairperson the well owner doing the emergency work shall submit to the Chairperson a pump installation report and a description of the emergency

Section 4.2 General Installation Requirements

(a) **Pumps and Pumping Equipment**

All installations of pump and pumping equipment on wells shall be constructed in such a manner as to prevent the pollution and contamination of the well from surface sources. Pumping systems shall be designed to not exceed the permitted pumping rate at the point of delivery when operating under normal design conditions.

(b) **Above-Grade Pump Connections**

All pump installations should be completed such that the top of the well casing extends a minimum of 12 inches above the prepared ground surface or pump house floor. If the pump is too heavy to permanently rest on the well casing then the reinforced concrete slab must extend at least 12 inches above the prepared ground level. For wells located in floodplains, the top of the well casing should extend at least two feet above the 100-year flood level.

(c) **Well Vents**

Well vents, when needed or used, shall permit air to freely enter and exit the well with changing water levels in the casing. Vents may be an integral part of the well seal or be attached to the seal and terminate a minimum of one (1) foot above the finished ground level, be turned down, and screened to prevent entry of vermin.

(d) **Water Level Measuring Device**

Public water supply wells shall have a means of measuring water level. Also wells with a pump capacity greater than 70 gpm or casing diameter above 6 inches shall also have a means of measuring water level. In some cases the Chairperson may also require

other wells to have a way of measuring water level. If a means of measuring water level is required by the Chairperson, the well owner or operator shall maintain the device in operating condition. The airline pressure gage or pressure transducer shall have an accuracy of 0.1 feet.

Water Level Measurement Access - An airline, water level sounding tube, permanent pressure transducer or other method approved by the Chairperson shall be installed on all wells whenever the permit issued by the Commission requires the installation of water level measuring equipment.

An airline tube shall consist of tubing extending from the wellhead to the top of the pump discharge case. This tubing shall be capable of withstanding the maximum pressures developed during use. The tube shall be securely fastened to the pump discharge case, column pipe or drop pipe. The specifications and depth of the airline shall be recorded on the Pump Installation Report.

The water level sounding tube shall have a minimum inside diameter of 3/4 inch. It shall extend from the wellhead to the top of the pump discharge case and shall be securely attached to the column or drop pipe so that it hangs straight and plumb. All water level sounding tubes shall be equipped at the top end with a removable cap or plug to prevent entry of foreign material. The bottom of the tube shall be constructed to allow the free entry and exit of water and to prevent the measuring device from passing out of the bottom of the tube.

(e) **Standards of Other Agencies**

The published standards for vertical turbine pump-line shaft and submersible types of the American Water Works Association (ANSI/AWWA E101-88) and as may be amended are incorporated by reference as a part of these Standards. In addition to these Standards, pump and pumping equipment installations for wells to be used by the Water Department of the respective Counties of the State of Hawaii shall meet the standards specified in "Water System Standards, State of Hawaii," 2002, and as may be amended.

Section 4.3 Pumps

(a) Mounting

Pumps shall be installed in such a manner that the well, pump and surrounding area can be kept in a sanitary condition, and will provide adequate protection against contamination from any surface or subsurface source. All pumping equipment shall be installed with an effective seal including a concrete pad at the top of the casing that will prevent the entry of contaminants into the well and support the weight of the pump and motor.

(b) Lubrication

If water lubrication is not adequate for a lineshaft pump, then oil-lubrication may be used for potable wells provided the oil lubricant conforms to USDA or FDA approved food contact grade formulations.

(c) Hazardous Materials

Pumps that contain mercury seals shall not be used in potable or non-potable wells.

(d) Potable and Non-Potable Interconnections

If the well is used to supply both potable and non-potable purposes in a single system, the user shall eliminate cross-connections and backflow connections by physically separating potable and non-potable systems by an air gap or an approved backflow preventor, and by clearly labeling all non-potable spigots with warning signs to prevent inadvertent consumption of non-potable water. Backflow prevention devices should be routinely inspected and tested. Further, if the well is used to supply non-potable purposes and the water system is used to distribute fertilizers, pesticides, herbicides, or any other irrigation-related chemical, commonly known as chemigation, the user shall install a backflow prevention device acceptable to the Department of Health, in accordance with §149A-31(6) HRS. This is to prevent accidental backflow contamination of the aquifer during chemigation.

Section 4.4 Water Meter

All discharge line configurations shall include an approved water meter (with a totalizer) or other appropriate device or means for measuring and reporting total water

withdrawal on a monthly calendar or work-schedule basis. The water meter shall be easily accessible and shall be installed according to the manufacturer's specifications. Owners/operators of salt water wells are not required to install a water meter unless otherwise specified by the Chairperson.

Section 4.5 Pump Installation Report

Within 60 days after the completion of a pump installation, modification, or repair, the permittee shall file with the Commission the following:

1. Pump installation report (on forms provided by the Commission).
2. As-built sectional drawing of the well and pump installation.
3. Pumping test record (if no pumping test conforming to these Standards has been performed).