



Australian Government

Department of Education, Employment and Workplace Relations

RIINHB411A Construct artesian (flowing) aquifer production bores

Release: 1

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Modification History

Not applicable.

Unit Descriptor

This unit covers construction of artesian (flowing) aquifer production bores in the drilling industry. It includes planning and preparing for construction including liaising with client and/or other relevant parties, designing production bores for artesian aquifer systems, constructing production bores in artesian aquifer systems, developing a bore, disinfecting/decontaminating bore and drilling equipment, carrying out bore maintenance and rehabilitation, and decommissioning artesian wells with flowing and/or nonflowing elements. Licensing, legislative, regulatory and certification requirements that apply to this unit can vary between states, territories, and industry sectors. Relevant information must be sourced prior to application of the unit.

Application of the Unit

This unit is appropriate for those working in an operational or supervisory role or as a technical specialist, at worksites within:

- Drilling

Licensing/Regulatory Information

Refer to Unit Descriptor.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Plan and prepare for the construction of artesian (flowing) aquifer production bores	1.1. Access, interpret and apply compliance documentation relevant to the work activity 1.2. Obtain, confirm and apply work instructions for the allocated task 1.3. Identify, manage and report all potential hazards 1.4. Resolve coordination requirements with others at the site prior to commencing and during work activities 1.5. Discuss scope of work with client and give technical advice, cost structure, workmanship warranty, quantity and quality of materials, construction standards and methods to be used and gain general agreement on drilling plan 1.6. Provide detailed strata logs, pump and development test results conducted during bore development and water and strata samples to the appropriate authorities as required by the relevant State/Territory legislation/licensing agency 1.7. Complete all requirements for bore completion reports, decommissioning or abandonment and send to regulatory authorities within the time specified on bore licence
2. Design production bores for artesian aquifer systems	2.1. Determine most appropriate construction methods from the reading and interpretation of all available documented information 2.2. Design the bore to ensure the exclusion of unsuitable waters and to prevent the inter-mixing of aquifers with different water quality and/or Standing Water Levels 2.3. Determine a drilling fluid program to suit the expected down-hole conditions and anticipated pressures 2.4. Select a bore site that will prevent contamination and minimise interference with other bores and that is safe with respect to potential occupational health and safety hazards 2.5. Select likely water entry mechanism from

	the formation to the bore such as open hole, slotted casing screens, gravel packs 2.6. Calculate appropriate artificial pack design parameters, and recommended annular thicknesses required 2.7. Undertake calculations to determine appropriate screen/slot design parameters (e.g. diameter, length, aperture size) 2.8. Plot and interpret sieve analysis results onto graphs 2.9. Select appropriate bore/surface casing types, size, strength and wall thicknesses for the anticipated ground/water quality and pressure conditions and any construction requirements 2.10. Ensure all necessary materials anticipated for the job are available and on site prior to commencement of construction phase
3. Construct production bores in artesian aquifer systems	3.1. Use approved procedures to select, slot, assemble and insert casing and screens suitable for the formations in which they are deployed 3.2. Use equipment for assembly and slotting safely and in accordance with approved procedures 3.3. Select, mix and place grout or otherwise seal surface casing from 10 m into competent impermeable strata and back to the surface with a minimum sheath thickness of 20mm above maximum shoe of coupling joint diameter size 3.4. Conduct grouting operations to seal intermediate and/or inner production casing strings with a 15mm minimum thickness grout sheath or to seal selected zones so that the water from the production bore is drawn from one primary formation only, (unless otherwise allowed by the permit) 3.5. Construct bore in accordance with any applicable regulations, minimum construction requirements and the organisation's internal procedures 3.6. Use and maintain drilling fluids and additives within the manufacturer's

	recommendations and that are non toxic and capable of complete removal from the bore upon completion 3.7. Maintain, test and record fluid properties such as viscosity, mud weight, filtration and sand content so that the potential capacity, efficiency or quality of the bore is not affected 3.8. Maintain plumbness and alignment of the hole within the required limitations and carry out a plumbness test if required 3.9. Prepare for and recognise symptoms of a formation kick and take action to control the bore 3.10. Collect, store, record, label and transport formation samples in accordance with licensing requirements 3.11. Collect, test, store, record, label and transport water samples for chemical analysis in accordance with licensing requirements 3.12. Maintain all records accurately and legibly 3.13. Arrange for geophysical logging tools to be run in bore if required 3.14. Accurately calculate hole, annular fill or pack materials and mud pit volumes in cubic metres or litres 3.15. Determine aquifer formation grain size distribution from sieve analysis and interpret appropriate gravel pack and screen slot aperture dimensions for gravel packed wells 3.16. Select appropriate gravel pack materials 3.17. Place artificial pack material in a manner that will ensure uniform distribution in the annular space without bridging 3.18. Comply with relevant workplace occupational health and safety requirements for both the drilling equipment and construction materials 3.19. Remove drilling fluids from the bore to allow subsequent development
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	3.20. Maintain tool string inventories 3.21. Construct headworks for the bore including isolation valves to retain/control artesian flow and to permit independent testing of both pressure and flow without interference to reticulation system 3.22. Identify and protect headworks of the bore 3.23. Construct headworks to seal and cap the bore from surface water pollutants, environmental concerns and damage 3.24. Dispose of/neutralise wastewater or hazardous materials from site and complete restoration of the bore site camp facilities
4. Develop bore	4.1. Use development techniques with care to prevent collapsing of casing or screens 4.2. Use development techniques to maintain and improve hydraulic transmissivity around the bore 4.3. Undertake development until a continuous, clean supply of water is obtained, in accordance with acceptable and practical limits set by site, contractual or regulatory requirements 4.4. Measure/calculate and record standing and drawdown water levels 4.5. Perform pump and or development tests to estimate the sand content and sustainable yield of the bore
5. Disinfect/decontaminate bore and drilling equipment	5.1. Disinfect/decontaminate to comply with relevant standards or regulatory requirements 5.2. Handle hazardous chemicals in accordance with manufacturer's recommendations/instructions and any relevant legislative/regulatory requirements
6. Carry out bore maintenance and rehabilitation	6.1. Undertake a process of diagnosis to determine likely cause of bore deterioration 6.2. Devise a program of rehabilitation to ensure that the bore is restored to a reasonable condition 6.3. Wear appropriate/recommended personal protective equipment when handling hazardous cleaning chemicals and follow

	manufacturer's recommendations
7. Decommission artesian wells with flowing and/or nonflowing elements	7.1. Determine suitable decommissioning procedures and select appropriate materials 7.2. Carry out the decommissioning (abandonment) of artesian aquifer bores, using min 20m long cement plugs sufficient to stem the flow between aquifers both from inside and outside the casing, (slot casing as necessary) or to separate aquifers of differing water quality from each other 7.3. Place cement bridges at the top of the surface casing and at the surface casing shoe 7.4. Verify position/location of hole for future reference 7.5. Dispose of drill and other fluids safely 7.6. Record entire decommissioning procedure and details of bore cementing 7.7. Complete bore completion report and submit to State/Territory Water Authority

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills

Specific skills are required to achieve the Performance Criteria of this unit, particularly for its application in the various circumstances in which this unit may be used. This includes the ability to carry out the following, as required to construct artesian (flowing) aquifer production bores:

- apply legislative, organisation and site requirements and procedures for supervision of the construction of artesian (flowing) aquifer production bores
- aquifer sand sieve analysis tests
- calculation of the specific capacity of a bore
- calculation of grout component quantities, i.e. cement powder, water and other additives as required
- calculation of hole and annular volumes
- calculation of grout specific gravity
- determination of grain size and selection of appropriate artificial pack material
- calculation of total pressure head for artesian aquifers
- calculation of mud specific gravity to control formation fluid pressure
- use and baryte and or salt to weight drilling fluids
- numerical including calculations such as:
 - volume (e.g. mud pits, drums, tanks or bore holes of given dimensions, annulus)
 - up hole velocity
 - cement/water/additives quantities
 - screen design parameters
 - flow rates (e.g. l/sec, GPM)
 - conversion from imperial to metric and vice versa
 - conducting a sieve analysis
 - required mud weight to control formation fluid pressures
- writing tasks including:
 - state/territory bore completion report
 - daily drill operation report
 - diagrams
 - brief descriptions
 - plotting information on a graph (e.g. plotting results from a sieve analysis)
- reading and interpreting materials including:
 - plans
 - diagrams
 - bore log

- graphs
- books

Required knowledge

Specific knowledge is required to achieve the Performance Criteria of this unit, particularly for its application in the various circumstances in which this unit may be used. This includes knowledge of the following, as required to construct artesian (flowing) aquifer production bores:

- legal requirements under the relevant State/Territory Water Act
- equipment - characteristics, technical capabilities and limitations
- basic geological formations, i.e. basic knowledge of both soil and rock classifications and various formations which permit groundwater movement and factors affecting groundwater quality rock/soil types including:
 - aquifer systems
 - drillability
 - stability
- potential safety hazards and sources of contamination when siting a bore
- the necessity of having a signed agreement/contract with the client
- requirements for water sampling for laboratory testing
- tests for alignment and plumbness of bores
- appropriate casing materials for various applications
- hole preparation for cementing (grouting) operations
- effects of various cement (grout) additives
- pressure cementing methods
- casing collapse characteristics
- applications for wire-wound screens
- screen design parameters to ensure appropriate entrance velocities
- interpretation of sieve analysis results
- applications for natural pack, stabilising fill and artificial pack completion techniques
- objectives of bore development
- test pumping procedures
- flow recession test procedures
- appropriate disinfecting chemicals and procedures
- appropriate headworks design for class 3 bore applications
- characteristics of 'good samples' required for water well construction
- ways in which sampling errors can occur
- types of drilling fluids, their selection, use, testing and conditioning
- problem solving techniques
- grout placement methods and procedures including pressure grouting
- range of numerical calculations
- relevant occupational health and safety requirements including principles of Duty

of Care

- appropriate fishing operations for the type(s) of drilling being undertaken
- use of materials safety data sheets (MSDS)

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	The evidence required to demonstrate competency in this unit must be relevant to worksite operations and satisfy all of the requirements of the performance criteria, required skills and knowledge and the range statement of this unit and include evidence of the following: • knowledge of the requirements, procedures and instructions for supervision of the construction of artesian (flowing) aquifer production bores • implementation of requirements, procedures and techniques for the safe, effective and efficient supervision of the construction of artesian (flowing) aquifer production bores • working with others to plan, prepare and conduct supervision of the construction of artesian (flowing) aquifer production bores • evidence of the consistent successful supervision of the construction of artesian (flowing) aquifer production bores
Context of and specific resources for assessment	• This unit must be assessed in the context of the work environment. Where personal safety or environmental damage are limiting factors, assessment may occur in a simulated environment provided it is realistic and sufficiently rigorous to cover all aspects of workplace performance, including task skills, task management skills, contingency management skills and job role environment skills. • Assessment of this competency requires typical resources normally used in a resources and infrastructure sector environment. Selection and use of resources for particular worksites may differ due to the site circumstances. • The assessment environment should not disadvantage the participant. For example, language, literacy and numeracy demands of assessment should not be greater than those required on the job.

	• Customisation of assessment and delivery environment to sensitively accommodate cultural diversity. • Aboriginal people and other people from a non English speaking background may have second language issues. • Where applicable, physical resources should include equipment modified for people with disabilities. Access must be provided to appropriate learning and/or assessment support when required.
Method of assessment	This unit may be assessed in a holistic way with other units of competency. The assessment strategy for this unit must verify required knowledge and skill and practical application using more than one of the following assessment methods: • written and/or oral assessment of the candidate's required knowledge • observed, documented and/or first hand testimonial evidence of the candidate's: • implementation of appropriate requirement, procedures and techniques for the safe, effective and efficient achievement of required outcomes • consistent achievement of required outcomes • first hand testimonial evidence of the candidate's: • working with others to undertake and complete the construction of artesian (flowing) aquifer production bores • provision of clear and timely instruction and supervision by the individual of those involved in the construction of artesian (flowing) aquifer production bores
Guidance information for assessment	Consult the SkillsDMC User Guide for further information on assessment including access and equity issues.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Relevant compliance documentation may include:	• legislative, organisational and site requirements and procedures • manufacturer's guidelines and specifications • code of practice • Employment and workplace relations legislation • Equal Employment Opportunity and Disability Discrimination legislation • licences including: • Water Well licence (Class 3) • Licence for particular drilling method such as: • cable tool • auger • rotary air • rotary mud • Bore Construction Permit • Bore Development/Works Approval • Australian standards (e.g. AS 2368 - Test Pumping Water Bores) • ARMCANZ <i>Minimum Construction Requirements for Water Bores in Australia</i> July 1997
Work instructions may come from briefings, handovers, plans and work orders and may be written or verbal, formal or informal and may include:	• nature and scope of tasks • specifications • quality of finished works • achieved targets • operational conditions • obtaining of required permits • site layout • out of bounds areas • worksite inspection requirements • lighting conditions • plant of equipment defects • coordination requirements or issues

	- contamination control requirements - environmental control requirements - barricade and signage requirements
Hazards may include:	working in proximity to drilling rig
Coordination requirements may include:	- regular up to date information on progress, and/or problems encountered to client and/or other relevant parties. - other equipment operators - maintenance personnel - supervisors - site personnel
Bore development may include:	- chemical - air lift surging and pumping - over pumping
Documented information may include:	- results of test hole - hydrogeological data and reports - geological data - old bore hole logs - results from sieve analysis tests - geophysical logging results
Design the bore may include:	- geophysical logs - physical samples - results of mechanical testing of soils - water test analyses - interpretation of soft/hard zones - losses of drilling fluid - bore log and in hole test results/measurements - records of nearby bores - geological maps
Procedures may include:	- solvent cement (PVC) - stainless steel screws (PVC) - welding (steel) - threaded (PC, FRP, ABS) - locking strip or wire rope casing joiners
Equipment for assembly and slotting may include:	- hand tools - power driven (electric, hydraulic or air) tools/equipment - casing lifter sockets - pipe cutter and beveller - welder and oxy cutter - solvent

	centralisers
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Unit Sector(s)

Drilling (General)

Competency field

Refer to Unit Sector(s).

Co-requisite units

Not applicable.