

# SPAIN BRIDGE MEADOWS SUBDIVISION WELL SPECIFICATIONS

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Domestic water supply for the development shall be facilitated by the construction of individual on-site domestic wells for each respective lot of the subdivision. Each individual well shall be certified by an engineer for verification of construction according to this well specification. Homesites will not be allowed to connect to their respective water supply wells prior to certification by a professional engineer.

## **PART 1. GENERAL**

- 1.1\_ SCOPE: The work to be done hereunder includes the furnishing of all labor, materials, transportation, tools, supplies, equipment and appurtenances, unless hereinafter specifically accepted, necessary for the complete and satisfactory construction, development, testing, cleaning and disinfection of the proposed water well.

Under these specifications, it is the intent of each owner to construct a water well for each respective individual lot. This water well shall supply each homesite with a primary source of potable water for domestic and irrigation purposes. The maximum yield from the new well is 35 gallons per minute (gpm). The new well intake shall be constructed with a minimum well intake depth of 80' below ground surface. The final well depth and production rate may vary depending on the types of geologic formations encountered. The CONTRACTOR shall provide a well pump capable of the flow determined for each site (maximum 35 gpm), with a Total Dynamic Head as measured at each site.

This water well must be constructed by a licensed Water Well Contractor and be in accordance with the Board of Water Well Contractors - Montana Codes Annotated, Administrative Rules of Montana (Title 37, Chapter 43, MCA and Title 36, Chapter 21, ARM, March, 1997).

- 1.2 PERMITS, CERTIFICATES, LAWS & ORDINANCES: The Contractor shall, at his own expense, procure all licenses and permits required of him by law for the execution of this work. He shall also comply with all federal, state and local laws, ordinances, rules and regulations relating to the performance of the work. The Owner shall provide all lands, right-of-ways, and permits required for the performance of, and access to, the work under this contract.
- 1.3 WARRANTY AND GUARANTEES: The Contractor shall warranty and guarantee to the well owner that all construction materials and equipment shall be new unless otherwise specified and that all work shall be in good quality and free from faults or defects and in accordance with the requirements of the drilling agreement and of any inspections, tests or approvals referred to in the drilling agreement (ARM 36.21.663). These warranties and

guarantees are void if the well owner does not give timely notice to the Contractor of all unsatisfactory work, all faulty or defective work and all work not conforming to the requirements of the drilling agreement or such inspections, tests or approvals. The warranty or guarantee period shall be a minimum of one year from the date of completion of the well.

1.4 LOCATION: The well to be constructed hereunder shall be drilled in the location that is indicated on the MDEQ Approved Site Plan drawing (most recent approval as recorded at the Gallatin County Clerk and Recorders at the time of each well construction). In order to ensure continued protection of the proposed well site, a 100' radius well protection zone has been indicated on the plan sheet. None of the site's sewer system improvements are located within the proposed well's protection zone. The location of this well must conform to ARM 36.21.638 which states the following:

1) At a minimum, water wells shall not be located within...

\* 50' of septic tanks, and underground storage tanks and associated lines.

\* 100' of drainfields, seepage pits or cesspools, or other on-site treatment systems.

1.5 LOCAL CONDITIONS: Before the local conditions are disturbed on the site, the Contractor shall promptly notify the Owner in writing of:

(1) Surface or subsurface conditions at the site that differ significantly from those indicated in this contract;

(2) Unknown or unusual physical conditions at the site that differ from those ordinarily encountered.

The Owner shall promptly investigate the conditions and if he finds that such conditions do significantly differ and cause an increase or decrease in the cost of or the time required for the performance of this contract, an equitable adjustment shall be made and the contract modified accordingly.

1.6 BOUNDARIES OF WORK: The Owner shall provide land or right-of-ways for the work specified in this contract and make suitable provisions for ingress and egress. The Owner shall not cause the Contractor to enter or occupy with men, tools, equipment or material, any ground outside the property of the Owner without the written consent of the Owner of such ground. Other Contractors and employees or agents of the Owner may for all necessary purposes enter upon the premises used by the Contractor, providing the operations of other Contractors do not interfere with the actual drilling operations. The Contractor shall conduct his work so as to not impede unnecessarily any work being done by others on or adjacent to the site.

1.7 PROTECTION OF SITE: The protection of the site shall comply with ARM 36.21.637. During the construction of the water well, the Contractor shall protect the well from contamination or pollution. Water extracted from the well during test pumping shall be

routed to an on-site location where it will be properly disposed of without damage to the surrounding property or the creation of a nuisance.

Except as otherwise provided herein, the Contractor shall protect all structures, walks, pipelines, trees, shrubbery, lawns, etc, during the progress of the work, and shall remove from the site all unused materials. Upon completion of the work, the Contractor shall restore the site as nearly as possible to its original condition, including the replacement, at the Contractor's sole expense, of any facility or landscaping which has been damaged beyond restoration to its original condition or destroyed. The Owner shall provide land or right-of-ways for water disposal facilities.

1.8 **WELL LOG REPORTS:** The licensed Water Well Contractor shall prepare a well log report form for the proposed water well. The Contractor shall supply a copy of the well log report to the Owner, Engineer, and such agencies as reported by sections 85-2-516 and 85-2-517, MCA, and maintain a copy as a record in his own files. The well log report should conform to ARM 36.21.639.

1.9 **GENERAL DESCRIPTION OF WELL CONSTRUCTION:** The completed water well shall consist of the following principal items (all items are approximate only):

1. 10" dia oversized borehole from 0'- 25'; 4" for grout
2. 6" dia (nominal) permanent steel well casing with drive shoe from **0' - 80'** (min);
3. Suitable bridge, packer, or bentonite seal at bottom of oversized borehole;
4. Cement grout from 0' - 25';
5. Open Hole, Casing perforations (dependent on aquifer location); or well screen.
6. Vented sanitary well cap assembly.

1.10 **COMPETENT WORKMEN:** The Contractor shall employ only competent workmen for the execution of the water well construction. All workmen shall be under the direct supervision of a Water Well Contractor that is licensed with the State of Montana.

1.11 **REFERENCED SPECIFICATIONS:** The publications listed below are referenced throughout the water well section of this plans and specifications document. These publications are referred to in this document by basic designation only.

1.11.1 **BOARD OF WATER WELL CONTRACTORS (ARM):**

- ARM 36.21.637 Protection Of Site
- ARM 36.21.638 Location Of Wells
- ARM 36.21.639 Well Log Reports
- ARM 36.21.640 Well Casing
- ARM 36.21.642 Steel Casing Joints
- ARM 36.21.643 Temporary Casing
- ARM 36.21.644 Casing Shoe
- ARM 36.21.647 Top Terminal Height
- ARM 36.21.649 Casing Centralizers
- ARM 36.21.650 Casing Perforations
- ARM 36.21.653 Well Development Procedures
- ARM 36.21.654 Sealing Of Casing - General

ARM 36.21.656 Sealing Of Unconsolidated Formations W/O Significant Clay Beds  
ARM 36.21.661 Temporary Capping  
ARM 36.21.662 Disinfection  
ARM 36.21.663 Warranty And Guarantees  
ARM 36.21.664 Tests For Yield And Drawdown  
ARM 36.21.667 Sampling Of Formations  
ARM 36.21.668 Water Samples  
ARM 36.21.669 Plumbness And Alignment Test  
ARM 36.21.670 Permanent Abandonment

1.11.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM A-120 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses

ASTM C-150 Specification for Portland Cement

1.11.3 AMERICAN WATER WORKS ASSOCIATION (AWWA):

AWWA A100 Standard for Plumbness and Alignment

1.12. MANAGERIAL, TECHNICAL, AND FINANCIAL RESPONSIBILITIES

The Spain Bridge County Water and Sewer District shall oversee the continued operation, maintenance, and water quality monitoring of individual domestic wells within the development. Proposed well construction for each individual lot will be financed by the individual lot owner.

Contractor shall provide engineer with manufacturer information (including, but not limited to: model number, material specifications, maintenance frequency and requirements, etc. This information shall be provided for all equipment used for construction of the water system (including, but not limited to: well, pitless adaptor, water line, pressure tank, valves, fittings, etc.)

## **PART 2. PRODUCT**

2.1 WELL CASING: The permanent well casing string shall conform with ARM 36.21.640. An 6" dia (nominal size) steel casing in a new or like new condition, being free of pits, breaks, or contamination, is to be used. This casing, which is to have a minimum outside diameter of 6.625" and a minimum wall thickness of 0.250", shall comply with ASTM A-120 standards. All steel casing joints (ARM 36.21.642) shall be welded or screw coupled and shall be watertight. The welding of the casing joints shall be done in accordance with the recommended standards of the American Welding Society. Sufficient passes of continuous weld shall be applied so that the finished surface at the area of fusion is built up to the surface of the adjoining pipe.

2.2 SEAL: An impervious seal such as a bridge, packer, or thick bentonite layer shall be placed at the bottom of the oversized borehole. This impervious seal shall separate the cement grout from the water bearing formation. This seal shall be of material that will not impart taste, odor, toxic substance or bacterial contamination to the well water.

- 2.3 CEMENT SEALING GROUT: The cement sealing grout shall be a portland cement grout that conforms to ASTM C-150. This grout shall contain a minimum of 5.3 sacks of portland cement per cubic yard and a maximum of 5 gallons of water per 94 lb sack of cement. The maximum slump shall be 4". Up to 5% by weight of bentonite clay may be used to improve flow and reduce shrinkage. No sand or gravel is to be used in cement grout. The mixture, method of mixing, and the consistency of the grout should be approved by the Engineer.
- 2.4 VENTED WELL CAP ASSEMBLY: The top of the well casing shall be covered with a factory manufactured, vented well cap or fabricated vent cap assembly. This cap will protect the well from the entry of rain water, foreign objects, and contamination. The cap and vent assembly shall be corrosion resistant and manufactured with a vent pipe oriented downward to prevent the entry of rain water. The down-turned end of the vent pipe shall be covered with a 24 mesh non-corrosive screen. The vented well cap assembly shall be of such design and strength as to be vandal resistant.
- 2.5 CENTRALIZERS: Well casing that is sealed into an oversize bore hole (approximately 25 feet) shall be equipped with centering guides (centralizers) to insure proper centering of the casing. Casings shall be centered in the sealed interval. Centralizers shall be made of steel at least ¼" in thickness, shall be spaced in groups of 3 or 4 and shall be spaced at a maximum of 20 foot intervals.
- 2.6 DRILLING FLUIDS & ADDITIVES:
- 2.6.1 TYPES OF DRILLING MEDIUM: Types of drilling medium acceptable for the drilling of this water well are:
1. Fresh Water
  2. Air
  3. Environmentally safe, fresh water based, bentonite drilling slurry
- 2.6.2 FLUID ADDITIVES: Additives to drilling fluids acceptable for the drilling of this water well are:
1. Inorganic phosphates
  2. Surfactants, drilling detergents, foaming agents
- Drilling fluids and additives shall be approved by the National Sanitation Foundation (NSF) or a similar ANSI accredited laboratory or organization.

### **PART 3. EXECUTION**

- 3.1 EQUIPMENT: The drilling equipment shall be in good operating condition. The depth of the water well is expected to be approximately 80' (minimum). Drilling bits shall be sized for the hole diameter specified. The drilling equipment shall be capable of drilling to a depth of 150'.

- 3.2 WASTE PIT: The Contractor shall construct his own waste pit for the containment of drilling fluids and wastewater. It shall be the responsibility of the Contractor to clean up the well site upon the completion of the work and restore the surface area to a near natural condition.
- 3.3 GROUNDWATER DISPOSAL: All groundwater that is discharged during the drilling, developing, and testing procedures shall be disposed of on the site's native soil, as long as, it is not hindering any other parties using the recreational development.
- 3.4 PROTECTION OF WATER QUALITY: The Contractor shall take necessary precautions to prevent environmental contaminants (petroleum hydrocarbons, hazardous substances, etc.) and water having undesirable physical or chemical characteristics from entering the underlying aquifer through the drill hole. All water used in drilling operations shall be clean, potable water. In the event that the well becomes contaminated or that water having undesirable physical or chemical characteristics does enter the well due to the neglect of the Contractor, he shall at his own expense, perform such work or supply such casings, seals, sterilizing agents or other materials as may be necessary to eliminate the contamination.
- 3.5 PROCEDURE FOR GENERAL WELL CONSTRUCTION:
  - 3.5.1 CONSTRUCTION OVERVIEW: The Contractor shall be responsible for leveling or grading the site as required for access and placement of all drilling equipment. The proposed well shall be drilled by the air rotary method. The material displaced by the bit shall be removed by a circulating drilling medium.

The well shall be drilled to the following diameters:

<u>Approximate</u> <u>Depth</u>	<u>Borehole</u> <u>Diameter</u>
00' - 25'	10"
25' – 80 (min)'	6"

The well shall contain the following sized casings:

<u>Approximate</u> <u>Depth Range</u>	<u>Nominal</u> <u>Size</u>
00' - 80'	6" (permanent)

- 3.5.2 BOREHOLE (OVERSIZED): According to the sealing requirements presented in the Board of Water Well Contractors - Montana Codes Annotated, Administrative Rules of Montana, an oversized borehole, which is no less than 3" wider than the permanent steel well casing, must extend a minimum of 25' below land surface. The oversized borehole for this water well shall be **10"** in diameter and extend to a depth of approximately 25'.
- 3.5.3 PERMANENT WELL CASING INSTALLATION: The permanent 6"(nominal) steel well casing shall be lowered into the oversized borehole to a depth of 25'. A drive shoe shall be welded on the bottom of the casing so that it can be driven to a final depth of approximately 80' (min). This casing shall extend above the finished ground surface no less than 18".

All the casing joints shall be welded or screw coupled and shall be watertight. If welded casing joints are used, the weld shall be a full penetrating weld at least equal in thickness to the wall thickness of the casing. Welded casing joints shall have a tensile strength equal to or greater than that of the casing.

- 3.5.4 BOREHOLE (REGULAR): A 6” dia borehole shall be drilled from 25' to approximately 80' (minimum). If this hole will not remain open during drilling, the 6” dia casing shall be driven along with the boring bit.
- 3.5.5 TEMPORARY CAPPING: At all times during the drilling operation, the Contractor shall protect the well in such a manner as to effectively prevent either tampering with the well or the entrance of foreign matter into it. Upon its completion, he shall provide and set a substantial screwed, flanged or welded cap specified by and satisfactory to the Engineer (ARM 36.21.661).
- 3.5.6 SEAL: An impervious seal such as a bridge, packer, or bentonite layer shall be placed at the bottom of the oversized borehole, located at a depth of 25' (approx.). The purpose of this seal is to prevent the cement grout from infiltrating into the producing formations via the outside of the well casing and reducing the output of the well.
- 3.5.7 SEALING & CEMENT GROUTING: Due to the unconsolidated deposits that underlie the recreational development, the cement grouting of the well annular opening, which is the space between the oversized borehole and the permanent casing, should conform with ARM 36.21.656. This section pertains to the sealing of wells in which the producing aquifer is overlain by unconsolidated formations such as sand and gravel without significant clay beds. Based on area well logs, thin clay layers are present beneath the site; however, their exact locations and thicknesses vary significantly due to differing depositional environments. Since it is unknown whether significant clay beds will be encountered during the drilling operation, the well's annular space shall be sealed according to ARM 36.21.656.

This water well shall be watertight to such a depth as may be necessary to exclude pollution, but in no case shall the cement sealing grout be less than 25' in depth from the ground surface. The annular opening between the permanent 6” steel casing and the 10” oversized borehole shall be filled with cement grout to a minimum depth of 25' in order to exclude pollution. The length of grout for this well shall be approximately 25'. At the bottom of the oversized borehole, a seal shall be placed to prevent the downward movement of the grout into the aquifer. This seal can either be a bridge, packer, or layer of bentonite.

Before proceeding with the placing of the grout, the Contractor shall secure the Engineer's approval of the method he proposes to use before starting the work. The permanent 8" steel well casing shall be sealed in accordance with ARM 36.21.656 - "Sealing Of Unconsolidated Formations Without Significant Clay Beds." No method will be approved that does not specify the forcing of grout from the bottom of the annular space up towards the surface. The grouting shall be done continuously and in such a manner as will insure the entire filling of the annular space in one operation. No drilling operations or other work in the well will be permitted until the grout has firmly set. The minimum setting time shall be 72 hours and this may be reduced if the Contractor can demonstrate that the cement grout has taken an

adequate set as determined by curing a sample of grout under similar conditions to that placed in the well. Quick setting cement may be used to accelerate setting time. The general specifications for water well sealing shall conform to ARM 36.21.654.

3.5.8 **TERMINAL WELL CONSTRUCTION:** The terminal well construction shall conform with ARM 36.21.647. The vented well cap assembly should extend no less than 18" above the finished ground surface. The ground surface immediately surrounding the cap assembly shall be graded so as to drain surface water away from the well. There will not be a well house constructed at the well head.

3.5.9 **CASING PERFORATIONS:** Depending on available well yield as measured during pump testing (35 gpm minimum), it may be necessary that casing perforations be installed in insure minimum aquifer and well yield requirements. Since the well intake is required to be more than 80' below ground surface (bgs), the casing perforations must be at least 80' bgs, which would involve extending the casing past the original anticipated depth of 80' bgs. The CONTRACTOR shall contact ENGINEER prior to installing any well casing perforations (if necessary). If perforations are necessary, they shall be within the aquifer formation itself. However, the location of the perforations for the well are currently unknown. Perforations shall be installed according to ARM 36.21.650.

### 3.6 **ADDITIONAL WELL CONSTRUCTION REQUIREMENTS:**

3.6.1 **LOG OF WELL:** The Contractor shall keep an accurate log of the well and record all of the well drilling operations which shall provide the following information:

1. The reference point for all depth measurements;
2. The depth at which each change of formation occurs;
3. The depth at which the first water was encountered;
4. The location and thickness of each aquifer;
5. The identification of the material of which each aquifer is composed;
6. The depth interval from which each water sample was taken;
7. The depth of the static water level (SWL) and observable changes in SWL with well depth;
8. Total depth of completed well;
9. Location limits of lost circulation zones;
10. Depth of well seal;
11. The nominal diameter of well bore;
12. The quantity of cement grout installed for the surface seal;
13. The depth and description of the well casing;
14. Data regarding the casing perforations; and
15. Development and pump test records.

3.6.3 **STRATIGRAPHIC LOG:** A stratigraphic log shall be prepared to accompany the set of drilling samples, noting: (1) depth; (2) strata thickness; and (3) lithology, including size, range, and shape of constituent particles, as well as particle roundness and rock type. The material shall be described according to the U.S.G.S. standard grade size scale as follows:



## MATERIAL CLASSIFICATION

Gravel  
Very coarse sand  
Coarse sand  
Medium sand  
Fine sand  
Very fine sand  
Silt and Clay

- 3.6.4 **PLUMBNESS & ALIGNMENT:** The borehole and well casing shall be set round, plumb and true to line as defined herein. The completed well shall be sufficiently plumb and straight so that there will be no interference with installation, alignment, operation or future removal of the permanent pump. To demonstrate the compliance of his work with this requirement, the Contractor shall furnish all labor, tools and equipment and shall make the tests described by, and to the satisfaction of, the Engineer. Tests for plumbness and alignment must be made after the complete construction of the well and before its acceptance by the Engineer. Additional tests, however, may be made by the Contractor during the performance of the work. Plumbness and alignment tests shall be described as listed below. This public water well shall be tested for plumbness and alignment in accordance with AWWA A100.

The Engineer may waive the requirements of this section for plumbness if, in his judgement:

- (a) The Contractor has exercised all possible care in constructing the well and the defect is due to circumstances beyond his control;
- (b) The utility of the completed well will not be materially affected; or
- (c) The cost for necessary remedial measures will be excessive.

In no event will the provisions of this section with respect to alignment be waived.

### METHOD A PLUMBNESS

Plumbness and alignment shall be tested by lowering a section of pipe or dummy into the well to a depth of 70' (lowest anticipated pump setting). The outer diameter of the plumb shall not be more than 1/2" smaller than the 6" diameter permanent well casing and borehole. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being not more than 1/2" smaller than the 6" diameter permanent casing and borehole. The rings shall be truly cylindrical and shall be spaced one at each end of the dummy and one in the center thereof. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings.

Should the dummy fail to move freely throughout the length of the well casing and borehole to a depth of 70' (lowest anticipated pump setting) or should the well vary from the vertical in excess of 2/3 the smallest inside diameter of the casing per 150' of depth, the plumbness and alignment of the well shall be corrected by the Contractor at his own expense and, should he

fail to correct such faulty alignment or plumbness, the Engineer may refuse to accept the well.

## METHOD B PLUMBNESS

Plumbness shall be tested by lowering into the well casing and borehole to a depth of 70' (lowest anticipated pump setting), a cylindrical plumb bob (12"-14" in length) and measuring the displacement of the plumb line at the top of the casing as described hereinafter. The cylindrical plumb bob shall have an outside diameter not less than ¼" smaller than the inside diameter of the 6" permanent casing and borehole and shall be heavy enough to stretch the plumb line taut. A #12 wire cable makes a good line that does not kink easily.

The line may be suspended from the derrick of a drilling machine or from a tripod with a winch. An adjustable guide shall be provided so that the plumb bob will hang in the exact center of the top of the well casing. The guide block shall be mounted so that the vertical distance from the centerline of the guide to the top of the casing is exactly 10'. With the plumb bob adjusted exactly in the center of the casing at the top, the test is conducted by lowering the plumb bob at 10' intervals and recording the distance that the plumb line moves off center at the top of the casing. Drift of the casing in inches at any depth is the measured displacement in inches of the plumb line multiplied by the total length in feet of the line between the guide block and plumb bob. This value is then divided by the fixed distance in feet between the guide block and top of casing (10').

Should the drift of the casing between any two measurements at 10' intervals exceed ½" or should the well vary from the vertical in excess of the smallest inside diameter of the casing per 150' of depth, the plumbness and alignment of the well shall be corrected by the Contractor at his own expense and, should he fail to correct such faulty alignment or plumbness, the Engineer may refuse to accept the well.

- 3.6.5 WATER SAMPLES: To determine the chemical and bacteriological quality of the groundwater which will be available from the individual water well, water samples shall be obtained during or immediately following construction and development (ARM 36.21.668). Sample bottles containing the samples shall be clearly marked indicating the location of the well, the date and time taken, and the depth from which the sample was collected. These water samples shall be packed to prevent breakage and analyzed as quickly as possible.

Upon completion of the well, the water samples shall be submitted by the contractor to a laboratory which is certified by the Montana Department of Environmental Quality (MDEQ) - Water Quality Division. Prior to sending the samples for analysis, the Contractor shall verify locations and certifications of labs with the Water Quality Division in Helena, Montana, Phone: (406) 444-4549. The following tests are required:

The individual wells must be monitored for:

1. Nitrates and Conductivity.

2. Coliform bacteria, upon completion of the installation of permanent pumping or transmission equipment but before the water is served to the individual well.

The quality of the water samples must meet the limitations set forth by the MDEQ - Water Quality Division before the well source can be placed into service. Private certified labs shall be used for analyses of the above parameters to encourage prompt service and prevent time delays in startup. The Contractor is to pay for all testing, sampling and shipping costs as required herein. All certified test results shall be submitted to the Owner, the Engineer, and MDEQ - Water Quality Division. If the following laboratories have maintained State certification, they can perform the required analyzes:

Energy Laboratories  
1107 South Broadway  
Billings, MT 59107  
Phone: (406) 252-6325

Montana Microbiological Services  
2010 North 7<sup>th</sup> Ave.  
Bozeman, MT 59715  
Phone: (406) 585-8160

Note: The Contractor will need to indicate to the laboratory that certified tests are required for both Nitrates and Conductivity, and Bacteria. Certification criteria may change for the above labs over time. It is the Contractor's responsibility to verify this prior to submitting water samples.

The Contractor shall send instructions with the samples that are submitted to the laboratory, requiring that the analysis be as per State of Montana requirements.

### 3.7 WELL DEVELOPMENT:

- 3.7.1 GENERAL: Upon completion of the well and before conducting the yield and drawdown tests, the Contractor shall surge and develop the well to remove all fines, drill cuttings, mud, drilling fluids, and additives. The method of developing and length of time of development shall be determined by the Contractor, Engineer, or Well Owner dependent on the type of water bearing formation encountered. The well development shall employ appropriate techniques designed to bring the well to its maximum production capacity and to optimize the well efficiency, specific capacity, stabilization of aquifer material and control of suspended solids. The development work should be started slowly and gently and increase in vigor as the well is developed.

### 3.8 PERFORMANCE OR PUMP TESTING:

- 3.8.1 PUMP TESTING - GENERAL: After the well has been completely constructed, developed and cleaned, the Contractor shall notify the Engineer or Owner and shall make the necessary arrangements for conducting a final pumping test. Yield and drawdown tests shall be

performed on every well after construction or subsequent treatment and prior to placement of the permanent pump.

The Contractor shall furnish and install necessary pumping equipment capable of pumping to the required point of discharge at a maximum capacity in excess of the anticipated lift and final production capacity of the well. The pumping level shall be field determined depending on the static water level and drawdown in the well. Throttling devices shall be provided to control the discharge to match the capacity of the aquifer and stabilize the drawdown.

As per ARM 17.36.322, a single family water system must provide a sustained yield of at least 10 gpm over a one-hour period, 6 gpm over a two-hour period, or 4 gpm over a four-hour period. The minimum pumping capacity shall be 1.5 times the anticipated maximum well pumping capacity of 35 gpm (1.5 X 35 gpm). The pumping unit shall be complete with drive unit controls and appurtenances and shall be capable of being operated without interruption for a period of 4 hours at 1.5 times the anticipated pumping rate. The Contractor shall furnish a power source to drive the pump.

**3.8.3 YIELD AND DRAWDOWN TEST:** Yield and drawdown tests shall conform with ARM 36.21.664. These tests shall:

1. Be performed in the well after construction or subsequent treatment and prior to placement of the permanent pump;
2. Have the test methods clearly indicated in the project specifications;
3. Have a test pump capacity, at maximum anticipated drawdown, at least 1.5 times the quantity anticipated;
4. Provide for constant rate pumping at 1.5 times the anticipated pumping rate for at least 4 hour. The anticipated pumping rate is a maximum of 35 gpm; therefore, the design pumping rate is 53 gpm. Data collection shall begin at time zero. The test may be terminated if stabilized drawdown occurs for at least 1 hour during the test
5. Provide the following data:
  - a. Static water level;
  - b. Starting time and ending time for each test cycle;
  - c. Pumping rate;
  - d. Pumping water levels taken so as to provide at least 10 evenly spaced data points per log cycle of time (in minutes) on a time-drawdown plot; and
  - e. Water recovery levels taken so as to provide at least 10 evenly spaced data points per log cycle of time (in minutes) on a time-drawdown plot.

All pump test data must be reported to the MDEQ before the new non-transient, non-community water well can be activated as a public water supply.

**3.8.4 WATER LEVEL MEASUREMENTS:** Water-level measurements shall be obtained prior to, during, and after the pump test in order to acquire background information (static water levels), the effects of pumping (pumping water levels), and a profile of recovery of the water level from the pumping level to the original state. The measurement frequency of water levels during pumping shall be such that adequate definition of the time vs. drawdown data is made available. The Contractor shall maintain a record of drawdown and yield by taking

readings at 1 minute intervals for the first 10 minutes, 5 minute intervals for the next 20 minutes, 10 minute intervals for the remainder of the 4-hour test.

3.8.5 PUMP TEST INTERRUPTION: The CONTRACTOR shall conduct the pumping test without any interruption or fluctuation that will affect the accuracy of the required pumping results. The anticipated pump capacity for the well shall be 67% of the design test capacity of the well.

3.9 CLEANING AND DISINFECTING:

3.9.1 GENERAL: Well disinfection shall be provided in accordance with ARM 36.21.662(1). After the well has been completely constructed and tested, it shall be thoroughly cleaned of all foreign substances, including tools, timbers, rope, debris of any kind, cement, oil, grease, joint dope and scum. The well casing shall be thoroughly swabbed, using alkalis if necessary, to remove oil, grease or joint dope. Following the completion of the water well, and again after the pumping equipment has been installed; the well and its equipment shall be disinfected by thoroughly agitating and mixing in the well a solution containing enough chlorine to leave a residual of 25 ppm throughout the well after a period of 24 hours. After the completion of the disinfection operation, the well shall be pumped to adequately flush the well of the disinfectant. One or more water samples shall then be obtained in sterilized containers and shipped to a state certified analytical laboratory bacteriological analysis. If samples prove to be unsatisfactory, the Contractor shall be required to repeat the disinfectant process until satisfactory results are obtained, unless the cause of pollution can be attributed to other sources.

3.10 SITE CLEANUP:

3.10.1 GENERAL: The Contractor shall restore the drill area to a state of cleanliness. Drilling cuttings shall be removed and disposed of away from the site. Waste pits shall be pumped out and backfilled with material from the original excavation.

3.11 WELL COMPLETION:

3.11.1 PUMP/MOTOR: The CONTRACTOR shall provide a well pump capable of the flow determined for each site (maximum 35 gpm), with a Total Dynamic Head as measured at each site.

3.11.2 DISCHARGE PIPING (COLUMN PIPING): The water well discharge piping shall be comprised of 1 ½" dia. Sch. 80 PVC drop pipe having threaded connections (iron pipe thread). Due to the anticipated depth of the drop piping column, each pipe connection shall be secured with a 1 ½" dia. galvanized coupling, rather than a 1 ½" Sch. 80 PVC coupling. The CONTRACTOR shall ensure that the column piping string is installed level and plumb. Prior to pump installation, the interior and exterior of the column piping materials (plastic) shall be thoroughly cleaned and swabbed of all oil, grease, or foreign substances, etc and adequately disinfected. The CONTRACTOR shall submit 3 copies of the discharge piping and coupling shop drawings to the ENGINEER for review and approval.

3.11.3 DISCHARGE PIPING (WATER SYSTEM): Discharge piping shall be protected against the entry of contamination. CONTRACTOR shall equip discharge piping in the building with a check valve, shutoff valve, pressure gauge and a smooth nosed sampling tap. Sampling tap shall be located at a point where positive pressure is maintained. An air relief valve shall be located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least 18 inches above the floor and covered with a 24 mesh corrosion resistant screen. The discharge piping shall be valved to allow for test pumping and control of the well and all piping, valves and appurtenances shall be protected from damage or freezing. Piping must be provided a means of pumping to waste but not be directly connected to a sewer. Piping from the pitless adapter to the new water line shall be 2" diameter PE pipe. Piping to the existing pressure tank indicates an existing 1" diameter galvanize pipe, however, the buried pipe size is unknown.

The pressure relieving device must prevent the pressure from rising more than 10% above the maximum allowable working pressure ( $1.1 \times 60 \text{ psi} = 66 \text{ psi}$ ), and that pressure gages must have a range of no less than 1.2 times ( $1.2 \times 66 \text{ psi} = 79.3 \text{ psi}$ ) the pressure at which the pressure relieving device is set to function. The CONTRACTOR shall provide exploratory excavation for connection to the existing buried water line and provide the necessary equipment, labor, materials (fittings, reducers, etc.) and necessary items for connection to this line.

3.11.4 CHECK VALVE: Two (2) check valves shall be installed in the column piping. One (1) valve shall be located immediately above the pump/motor assembly and other midway in the vertical piping between the pump/motor assembly and the pitless adapter. The valves shall be 1 1/2" in diameter, have a 150 psi pressure rating, be of the spring/silent type, and have threaded connections. A Simmons check valve is recommended or approved equal. The CONTRACTOR shall submit 3 copies of the check valve shop drawings to the ENGINEER for review and approval.

3.11.4 PITLESS ADAPTER: The pitless adapter shall be of the weld-on type for a 6" dia steel casing, have a 1 1/2" dia. threaded drop pipe opening, and a 1 1/2" dia. threaded discharge pipe nipple. A 1 1/2" Maass pitless adapter (model # 6J2) is recommended, or approved equal. CONTRACTOR shall permanently weld pitless adapter in place and ensure that an adequate seal exists between the well casing and the pitless adapter. The CONTRACTOR shall submit 3 copies of pitless adapter shop drawings to the ENGINEER for review and approval.

3.11.5 HYDROPNEUMATIC (PRESSURE) TANK: CONTRACTOR shall install a new pressure tank having an operating range of 40 psi – 60 psi and capacity to limit cycling in accordance with pump manufactures recommendations. In lieu of a pressure tank the CONTRACTOR or OWNER may use a variable speed drive such as Grundfos SmartFlo System.

3.11.6 WATER SERVICES AND PLUMBING: Water services and plumbing must conform to the Uniform Plumbing Code as amended by ARM 8.70.302.