

Special Improvement District No. 5 Large Capacity Augmentation Well #2

Addendum No. 1

This addendum is issued in reference to various parts of the Plans and Contract Documents and to document responses of questions from potential Bidders. The following information shall be incorporated in the referenced Contract Documents and Specifications:

1. SLV REC has not finished the design for the electrical service, for bidding purposes assume the new well will be within 100 feet of the electrical service.
2. A revised specification for Item 2 – Drilling and Testing of Augmentation Well is enclosed.
 - a. The louvered well screen has been changed to be a Roscoe Moss Brand Ful Flo screen with a 20.00” outer diameter or similar.
 - b. The specific distances to the stock well and the high capacity well water sources have been provided.



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Enclosures:

Revised Specification for Item 2 – Drilling and Testing of Augmentation Well

ITEM 2 - DRILLING AND TESTING AUGMENTATION WELL

2.1 GENERAL

The WORK required under this solicitation includes drilling one water well; furnishing and installing surface casing, pump chamber casing, and well screen assemblies; furnishing and placing filter pack, grout pads and seals; furnishing, installing, and removing developing equipment; developing and cleaning the well; sterilizing the well; furnishing, installing, and removing test pumping equipment; test pumping the well; capping the well; cleaning up and restoring the drill site, keeping RECORDS and providing a well construction drawing, well construction and pumping REPORT to OWNER.

The CONTRACTOR shall be a State licensed well driller and pump setter. The CONTRACTOR, at the CONTRACTOR's own expense, shall procure all permits, certificates and licenses required by him by law for the execution of his WORK, with the exception of the well permit. The well shall be constructed in accordance with the laws of the State of Colorado, this solicitation, and the DRAWINGS. The OWNER has in his possession the necessary permit for drilling the well.

The approximate location of the well is shown on the DRAWINGS. The final location of the well will be determined by the OWNER.

The water well shall have a nominal screen size of ± 20 inches O.D. in diameter, as specified herein.

The depth of the water well will depend upon subsurface conditions. It is expected the total depth of the well will be approximately 220 feet, depending on strata encountered, the final well permit, and the CONTRACTOR'S estimation of well production.

The dimensions of the well shall be as shown on the DRAWINGS.

Subsurface materials to a depth of 220 feet are described in the supplemental well information below.

2.2 DRILLING PROGRAM

Within **10 calendar days** after date of receipt of NOTICE TO PROCEED, the CONTRACTOR shall submit to the ENGINEER for approval a complete and practicable drilling program. The program shall show in detail the proposed drilling methods and sequence of drilling operations and shall provide for orderly performance of the WORK.

The program shall be in such form and detail as to show the following:

- A. Sequence of drilling operations.
- B. The days of week and month that WORK is to be performed.

- C. The number and length of each shift per day. The length of a shift may be extended in the field as required to avoid interrupting a drilling and testing operation.
- D. Type of drilling fluid to be used and plans for mud pits and pumps.

The CONTRACTOR shall revise the program as necessary to keep it current, and such revisions shall be submitted to the ENGINEER for approval.

Timely submittal of the drilling program and any revisions are required. The OWNER must have the information contained in the drilling program for such purposes as scheduling of inspectors and survey crews.

The cost of all WORK required by this paragraph shall be included in the prices BID in the schedule for other items of WORK.

2.3 EQUIPMENT

- A. Drilling and test pumping equipment: The CONTRACTOR shall provide standard drilling and test pumping equipment of types approved by the ENGINEER, but such approval shall not constitute any assurance by the OWNER of the adequacy of the equipment approved for use in performing the WORK specified. The drilling and test pumping equipment shall be disinfected with a sodium hypochlorite solution of the strength specified below. The method and procedure of disinfecting the equipment shall be according to State of Colorado regulation for water supply wells.

Hypochlorite Concentration Percentage (approximately)

5%	10%	15%	20%
6 liquid ounces	3 liquid ounces	2 liquid ounces	1-1/2 liquid ounces

- B. Costs: The cost of complying with the requirements of this paragraph shall be included in the prices BID in the schedule for other items of WORK.

2.4 SEQUENCE OF CONSTRUCTION FOR THE WELL

The CONTRACTOR shall follow the sequence listed below for construction of the well:

- A. Drill the hole for the surface casing to the specified depth or as directed by the ENGINEER. The diameter of the hole shall be large enough to provide a minimum 1-1/2-inch-thick grout seal around the surface casing.
- B. Install the surface casing to the top of the confining clay. Plumb the casing.

- C. Grout the annular space around the outside of the surface casing. Grout is to extend from the surface to the bottom of the confining clay layer separating RDGSS model layers 1 and 2. Pull temporary casing, if used. Permit minimum 24-hour grout setup time.
- D. Stockpile and assemble at the site all necessary casing, well screen, filter pack, other materials, equipment, and tools necessary to drill and complete the well. This will be required before beginning WORK in step (e) below.
- E. Drill the hole for the pump chamber casing, well screen, and filter pack from the bottom of the surface casing to the total depth of the well as directed by the ENGINEER. Circulate fluid or otherwise clean the hole.
- F. Pull the drilling tools and sound the hole for depth and condition. The hole shall be cleaned of sediment to the satisfaction of the ENGINEER prior to installation of the grout pad, pump chamber casing, and well screen.
- G. Place a pre-cast grout pad of suitable size in the bottom of the hole using a string of pipe with a disconnect joint.
- H. Install the screen assembly and the pump chamber casing down to the grout pad (measure exact length of assembly before installing).
- I. Place filter pack such that the screen and smooth casing assembly remains centered in the hole.
- J. Weld plate supports between pump chamber casing and surface casing.
- K. Develop the well immediately following installation of well components. Pump from the well while developing.
- L. Sterilize well.
- M. Install test pump and test the well.
- N. Replace test pump with production pump (if different) and seal the well.

2.5 DRILLING

- E. General: The well shall be drilled to diameters adequate to accommodate casings, grout seals, and filter pack as shown on the DRAWINGS.

The well shall be drilled by the reverse rotary method or by other methods approved by the ENGINEER so as to properly maintain the hole and not damage the aquifer. If other drilling methods are proposed by the CONTRACTOR, the CONTRACTOR shall satisfy the ENGINEER that the methods proposed to be used will result in a well meeting the requirements and intents of the plans and SPECIFICATIONS set forth herein.

- B. Drilling fluid: Use of drilling fluid shall be limited to water or water with bentonite type drilling fluid additive. No chemicals shall be used to clean out the well after drilling. NO CHEMICALS CONTAINING PHOSPHORUS SHALL BE USED IN ANY STAGE OF THE WELL DRILLING. Regardless of the fluid used for drilling, fluid properties and circulation velocity must be adequate to maintain the hole and remove all solids, including gravels from the hole. The use of formaldehyde, hydrochloric acid, and other similar chemicals in the construction of the well will not be allowed.

Regardless of the drilling fluid used, the CONTRACTOR shall disinfect the water used for drilling fluid with sodium hypochlorite. The addition of the disinfectant shall produce a concentration of about 50 parts per million (p/m) of chlorine in the water. To obtain a concentration of 50 p/m, the following dosages, depending on the sterilant concentration, shall be added to each 50 gallons of water.

Hypochlorite Concentration Percentage (approximately)

5%	10%	15%	20%
6 liquid ounces	3 liquid ounces	2 liquid ounces	1-1/2 liquid ounces

- C. Drilling: The well shall be drilled and cased sufficiently straight and plumb to meet the requirements of section 2.7 in order to permit the installation and removal of test pumping equipment provided for in section 2.13. If the well fails to meet the plumbness requirements, it shall be corrected by the CONTRACTOR at his/her own expense or may be rejected and considered an abandoned well as provided for in section 2.8.

The well shall be overdrilled at least 1 foot, and a grout pad shall be placed in the bottom as specified in section 2.9 and shown on the DRAWINGS.

The CONTRACTOR shall be responsible for providing water for drilling, developing, and other purposes, and for disposal of such water. A water source in the form of a small stock well will be available within 2,000 feet of the PROJECT site. A 1,000 gallon per minute high capacity well will be available within 6 miles driving distance of the PROJECT site. The water shall be clear and free from foreign matter. Disposal of water from developing and test pumping will be in accordance with provisions of section 2.13.

- D. Landscape Preservation: Materials excavated from the well shall be disposed of and spread in an area within ±30 feet of the well in a manner and at a location approved by the ENGINEER. Generally, these materials shall be spread and leveled to conform as nearly as possible to the original ground surface at the drill location, any equipment ruts and mud pits shall be filled, and cleanup shall be performed as follows:

- (E) General: The CONTRACTOR shall exercise care to preserve the natural landscape and shall conduct his/her construction operations so as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the WORK.

No special reseeding or replanting will be required under this solicitation; however, on completion of the WORK, all WORK areas shall be scarified and left in a

condition which will facilitate natural revegetation, provide for proper drainage, and prevent erosion. All unnecessary destruction, scarring, damage, or defacing of the landscape resulting from the CONTRACTOR'S operations shall be repaired, replanted, reseeded, or otherwise corrected as directed by the ENGINEER and at the CONTRACTOR'S expense.

- (2) Mud pits: When no longer required by the CONTRACTOR, mud pits shall be filled in and smoothed over to conform as nearly as possible with the original ground surface.
- (3) Costs: The cost of all WORK required by this paragraph shall be included in the prices BID in the schedule for other items of WORK.

- E. Measurement: Measurement for payment for drilling holes to accommodate surface casing and grout seal shall be made to the nearest foot from the original ground surface to the bottom of the grout seal. Measurement for payment for drilling holes for the well shall be made to the nearest foot from the bottom of the grout seal to the bottom of the hole or to the depth of drilling, whichever is less. The CONTRACTOR shall make all such measurements in the presence of the ENGINEER.
- F. Payment: Payment for drilling holes will be made at the applicable contract unit prices per linear foot BID, which unit prices shall include all costs of furnishing, operating, and removing equipment; all costs of providing, sterilizing, and disposing of drilling water and other fluids; all costs of disposing of excavated materials and unused supplies; and all costs of normal site cleanup, which includes cleaning up and restoring the drill site to as near its original condition as practicable.

Payment for placing the grout pad will be made in accordance with the provisions of section 2.9.

2.6 CASING

- A. General: Permanent well casing shall be furnished and installed by the CONTRACTOR as shown on the DRAWINGS. Casing for the well shall be new black steel pipe and shall be manufactured in accordance with API Standard 5L of the American Petroleum Institute or equivalent ASA or ASTM Standards. Each piece of permanent casing shall be factory-stenciled or otherwise marked to properly identify the casing.

Sections of casing shall be joined by butt-welding. Welding shall be performed by a qualified welder, and such welding shall be multiple pass, full continuous running welds in accordance with standards of the American Welding Society. Casing ends shall be beveled before welding. All pump chamber-casing interiors will be free of slag, burrs, or other roughness after welding. The CONTRACTOR shall provide and utilize a jig to assure that casing is accurately aligned during welding. The jig provided will be subject to approval by the ENGINEER.

Casing strings shall be suspended in tension from the surface during well construction.

- B. Surface casing: Surface casing shall be installed in the well to the depth as shown on the DRAWINGS and/or as directed by the ENGINEER. The casing shall be centered in the hole. The casing shall be driven approximately 1 foot into the bottom of the hole, and the annular space around the casing shall be filled with a grout seal in accordance with the provisions of section 2.9.

Diameter, weight, and wall thickness of the surface casing are shown in Table 2A.

Table 2A. – Surface casing		
Size, outside diameter (inches)	Weight (lb per ft)	Wall thickness (inches)
28	110.6	0.375

- C. Pump chamber casing: Pump chamber casing shall be attached to the well screen and installed in the well as shown on the DRAWINGS and/or as directed by the ENGINEER. The length of the pump chamber casing installed at the well shall be as shown on the DRAWINGS.

The pump chamber casing shall be centered in the well and shall be supported on two ¼ inch-thick steel plate supports welded between the pump chamber casing and the surface casing as shown on the DRAWINGS.

Diameter, weight, and wall thickness of the pump chamber casing are shown in Table 2B.

Table 2B. – Pump chamber casing		
Size, outside diameter (inches)	Weight (lb per ft)	Wall thickness (inches)
20	78.60	0.375

- D. Temporary casing: The CONTRACTOR may use temporary casing as required for construction of the well; provided that such temporary casing shall be removed on completion of the well.

No separate payment will be made for furnishing, installing, and removing temporary casing.

- E. Capping well: On completion of all WORK, including testing at the site, the well shall be capped and sealed with an elbow extending out of the top as shown on the DRAWINGS. The cap will have a cable hole and eye bolt for connection to safety cable. The eye bolt shall be rated for a minimum load of 1,000 lbs. While under construction and no personnel are present at the well site, the well shall be temporarily capped as approved by the ENGINEER.
- F. Measurement and payment: Measurement for payment for furnishing and installing surface casing and pump chamber casing will be made to the nearest 0.5 foot measured along the centerline of the casing. Such measurement shall include only the permanent casing actually installed and left in place as specified herein and shown on the DRAWINGS.

Payment for furnishing and installing surface casing and pump chamber casing will be made at the applicable contract unit prices per foot BID. The unit prices BID in the schedule shall include all costs of furnishing and installing the casing; all costs of furnishing, installing, and removing temporary casing; and all costs of furnishing and installing casing supports, cover plates, and fittings.

2.7 PLUMBNESS

The well shall be completed plumb and straight. When installed, the pump chamber casing shall not deviate out of plumb more than 50 percent of its inside diameter, measured between the ground surface and the top of the screen assembly.

On request by the ENGINEER, the CONTRACTOR shall test the well for plumbness by running a plumb ring or cage to the top of the screen assembly in accordance with AWWA Standard A100, Section A1-9. The plumb ring or cage shall be approximately 1 foot long and ¼ inch smaller in diameter than the inside diameter of the casing.

Any correction to the well necessary to meet the plumbness requirements shall be made by and at the expense of the CONTRACTOR. The cost of testing the well for plumbness shall be included in the prices BID for the various items of WORK.

2.8 ABANDONMENT

Any well that does not meet the plumbness or other requirements or is “lost” (abandoned by CONTRACTOR due to not fulfilling requirements of this solicitation) before reaching the required depth or completion, or any well on which the CONTRACTOR voluntarily stops WORK before completion will be considered an abandoned well. The ENGINEER may require abandonment of a well if the hole below the surface casing has collapsed and has been redrilled to a point that it is considered excessively oversized. The CONTRACTOR, at his/her own expense, shall pull any ungrouted casing and screen assembly from an abandoned well and shall seal the well in accordance with State of Colorado regulations. No payment will be made for any item of WORK on an abandoned well. In the event that a well is abandoned, a new well shall be drilled in the drill site vicinity at a location designated by the ENGINEER.

2.9 GROUT SEAL AND PRECAST GROUT PAD

A. Grout seal: The annular space between the surface casing and the wall of the hole shall be sealed with grout as specified in this paragraph and shown on the DRAWINGS. Grout shall be placed by pumping through a tremie pipe extending initially to the bottom of the hole or by other approved methods which will assure complete filling of the annular space from the bottom upward in one continuous operation. Pipe shall be black iron or PVC plastic. Under no circumstances shall galvanized pipe or aluminum pipe be used. Temporary conductor casing, if used, shall be gradually pulled back as the grout is placed. At no time shall the grout level be permitted to fall below the bottom of the conductor casing during grouting. The minimum thickness of the grout seal shall be 1½ inches.

The surface casing shall be installed from the bottom of the confining clay layer separating RGSS Model Layers to the surface. This grout seal shall extend from the surface of the borehole to the bottom of the confining clay layer.

- B. Grout plug: A grout plug shall be placed in the bottom three feet of the well. The grout plug shall be installed through the use of a tremie pipe or attached to the bottom of the well screen and set when the screen is installed.
- C. Materials: The grout shall be either neat cement grout or neat cement grout with accelerator as directed by the ENGINEER. The neat cement grout shall consist of one sack (94 pounds) of Portland cement and approximately 5½ gallons of water. The neat cement grout with accelerator shall consist of one sack (94 pounds) of Portland cement, approximately 5½ gallons of water, and a maximum of 2 pounds of 70 to 80 percent calcium chloride flakes. Cement shall be type II, low-alkali Portland cement in accordance with ASTM C 150. Water shall be free from objectionable quantities of silt, organic matter, salts, and other impurities.

The CONTRACTOR is to provide to the ENGINEER a receipt or other documentation of the quantity of grout seal placed in the annular space between the surface casing and borehole. The ENGINEER is to be contacted at least (2) days prior to installation of each grout seal to permit observation of installation.

- D. Placement of grout: The neat cement grout shall be placed within 1½ hours after mixing and before the temperature of the grout exceeds 90 degrees F. Any neat cement grout not placed within 1½ hours after mixing or exceeds 90 degrees F shall be wasted at the expense of the CONTRACTOR.

The neat cement grout with accelerator shall be placed immediately after mixing and before the temperature of the grout exceeds 90 degrees F. Any neat cement grout with accelerator that is not placed immediately after mixing or that exceeds 90 degrees F shall be wasted at the expense of the CONTRACTOR.

Following placement of the grout seal, no WORK shall be done on the well for a period of at least 24 hours.

- E. Measurement and payment: Measurement and payment for furnishing and placing grout in the annular space around casing and for furnishing and placing the bottom grout plug will be made on a lump sum basis in the BID schedule for furnishing and placing grout seals and pads, which unit price shall include all cost of furnishing, mixing, and placing the grout and all costs of providing cement, water, and any additives used.

Payment will not be made for grout that is wasted.

2.10 WELL SCREEN ASSEMBLIES

- A. General: The CONTRACTOR shall furnish the well screen in sufficient numbers of 10-, 20- and 40-foot lengths to make up the well screen assemblies in the specified lengths. Well screen assembly components will be furnished by the CONTRACTOR and shall be welded

together and installed by the CONTRACTOR in the well as shown on the DRAWINGS and as directed by the ENGINEER.

As part of this BID, two well screening options are to be provided. The ENGINEER, CONTRACTOR, and OWNER will discuss the optimal screening type and opening dimensions after the winning BID has been selected.

Option A)

Option A shall be 0.060” slot Johnson 304-stainless steel Wire Wrapped Screen, or similar. The length of well screen will be from approximately 90 feet. The screen slot size may change based on the results of the test hole analysis.

Option B)

Option B shall be 0.060” slot 304-stainless steel Ful Flo Louvered Well Screen, or similar. The length of well screen for the will be from approximately 90 feet. The screen slot size may change based on the results of the test hole analysis.

B. Well Screen Specifications for Each Option

Option A: Johnson well screen assemblies or similar:

(1) General: Well screen assemblies shall consist of wire wound, cage-type well screen with collar extension for welding.

The well screen shall be constructed of stainless steel and be of continuous slot type design. The screen shall be fabricated by welding to insure adequate strength to resist the external forces to which it will be subjected during and after installation. Screen openings shall be V-shaped, widening inwardly to permit fine particles to pass through without clogging during development of the well.

(2) Well screen: The well screens shall be wire wound, cage-type, continuous slot, shaped wire, V-slot screen of all-welded construction, conforming to the SPECIFICATIONS shown in Table 2C.

Screen slot widths shall not vary more than ± 0.004 inches from the specified widths shown in Table 2C. The slot width shall be clearly marked on each section of screen. The slots shall be completely clean and free of burrs, frayed ends, or cuttings. Each length of screen shall be joined by welding to make up the total screen length for the well.

Table 2C. – Well screen dimensions

1 Screen outside diameter	2 Type of steel	3 Slot width	4 Minimum intake area	5 Minimum collapse resistance
(in) 19.9	304-Stainless Steel	(in) 0.060	(in ² /ft) 237	(lbs/in ²) 56

Option B: Roscoe Moss louvered well screen assemblies or similar:

(1) General: Well screen assemblies shall consist of a casing perforated with machine made opening facing downwards. All openings are to be horizontal to the axis of the casing and of a louver style.

The well screen shall be constructed of 304 stainless steel and be of louvered slot type design. The screen shall be fabricated by a perforating machine and welding to ensure adequate strength to resist the external forces to which it will be subjected during and after installation. Screen opening shall widen inwardly to permit fine particles to pass through without clogging during development of the well.

(2) Well screen: The well screens shall be machine perforated louver type screen of all-welded construction, conforming to the SPECIFICATIONS shown in Table 2D.

Screen slot widths shall not vary more than ± 0.004 inches from the specified widths shown in Table 2D. The slot width shall be clearly marked on each section of screen. The slots shall be completely clean and free of burrs, frayed ends, or cuttings. Each length of screen shall be joined by welding to make up the total screen length for the well.

Table 2D. – Well screen dimensions

1	2	3	4	5
Screen outside diameter	Type of steel	Slot width	Minimum intake area	Minimum collapse resistance
(in) 20.00	304-Stainless Steel	(in) 0.060	(in ² /ft) 30.24	(lbs/in ²) -

- D. Welding well screen assemblies: The welding of screen assemblies, including the welding of sections of screen to one another and to fittings, shall only be done in conformance with the screen manufacturer's recommendations and standards of the American Welding Society by experienced and competent welding personnel. The CONTRACTOR shall obtain from the screen manufacturer specific welding recommendations in manual or similar form for field welding. Such recommendations shall include electrode types, polarity, etc. One copy of the recommendations shall be provided to the ENGINEER 20 days prior to installation of the screen assemblies. The CONTRACTOR shall furnish all welding equipment and rods necessary for welding the well screen components together. All well screen interiors and exteriors shall be free of slag, burrs, or other roughness after welding. The CONTRACTOR shall provide and utilize a jig to assure that the well screen is accurately aligned during welding. The jig provided shall be subject to approval of the ENGINEER.
- E. Installation: The well screen assembly shall be installed in one string to the bottom of the well. Each screen or smooth casing joint shall be welded to the next as it is installed.

- F. Measurement and payment: Measurement for payment for furnishing and installing steel well screen assemblies will be made to the nearest tenth of a foot of the actual well screen and collar furnished and installed in the well.

Payment for furnishing and installing the various sizes of steel well screen assemblies will be made at the applicable contract unit prices per linear foot, which unit prices shall include all costs of furnishing, hauling, handling, welding, and installing the screen assemblies as required by this paragraph.

Two well screen options are to be provided by the BIDDER as per the above SPECIFICATIONS. The final screen selected for installation will be chosen by the OWNER from the options.

2.11 FILTER PACK

- A. General: Filter pack shall be furnished and placed by the CONTRACTOR into the well as specified in this paragraph and shown on the DRAWINGS. The typical size of pack that may be used in the well is 0.066" to 0.079". This SPECIFICATION is to be used for BIDDING purposes only. The size of the filter pack material may change based on the recorded formation as observed during drilling.

- B. Pack material: Pack material shall be Johnson Brand Shur Pak 10-12.

The filter pack delivered to well sites in the field shall be subject to analysis and will be rejected, if found to fall outside the specified limits with allowed variation.

- C. Placement: If water has been used in drilling, the pack shall be placed by adding at the surface through a hopper with a minimum capacity of 2 cubic feet or by other means approved by the ENGINEER. Placement shall be slow and continuous in such a manner as to minimize bridging or segregation of the pack.

Filter pack placement shall begin following installation of the well screen/pump chamber casing assembly. The pack level shall be brought to 10 feet above the well screen.

Following placement of filter pack, the well shall be lightly surged above the screen for a period of not less than 15 minutes in order to settle the pack.

During development and test pumping, the level of the pack shall be measured periodically and replenished as necessary to ensure that the pack level does not fall to less than 10 feet above the screen. On completion of development and test pumping, pack material shall be added to bring the pack level to 10 feet above the screened portion.

- D. Measurement and payment: Measurement and payment for furnishing and placing filter pack will be made on a lump sum basis therefore in the schedule, which unit price shall include the cost of furnishing and placing the pack and surging the well to settle the pack. The material specified herein shall be subject to change.

2.12 DEVELOPING WELL

A. General: The augmentation well shall be initially developed by airlift pumping. A secondary step of development will consist of a minimum (1) of these (3) options below:

1. Jetting, as per section 2.12 B
2. Combined Jetting and Surging as per section 2.12 C
3. Cable tool Surging, as per section 2.12 D

Prior to and upon completion of development, the CONTRACTOR shall bail or pump any material remaining in the bottom of the well.

Any water used for well development must be hauled to the site, however; a water supply is available within 1 mile of the proposed well site. The water shall be sterilized in accordance with section 2.5 B, however chlorine concentration of water shall be no less than 200 p/m.

Final development shall be done by surging and pumping as provided for in section 2.12 E.

If at any time during development that the depth of material accumulated in the bottom of the well exceeds 2 feet, the material shall be removed by bailing or pumping before developing can be resumed.

On completion of development, all equipment shall remain the property of the CONTRACTOR.

B. Developing by Jetting: The CONTRACTOR shall provide to the ENGINEER specific sequences of development by jetting.

Equipment for jetting shall include (1) a high-pressure jetting tool similar to that shown on the DRAWINGS; (2) a high-pressure pump; (3) necessary hoses, valves, gauges, pipes, etc.

A pressure gauge showing pumping pressure up to 400 pounds per square inch shall be installed on the pumping system. All components of the jetting equipment shall be designed to safely operate at a maximum pressure of 350 pounds per square inch with an adequate safety factor.

During jetting, approximately 5-foot intervals of the screen shall be developed by slowly raising and lowering the jetting tool while rotating the tool a few degrees after each cycle of raising and lowering until the entire interval has been jetted. Following this, each successive 5-foot interval shall be covered.

The development shall be done in a careful and systematic manner to assure complete development without damage to the aquifer or screen. Development shall continue until the sand particles in the pump discharge are reduced to a concentration acceptable to the ENGINEER.

At no time shall both the rotational and vertical movement of the tool be permitted to stop while jetting is underway.

Upon completion of development by jetting, the well shall be cleaned of accumulated material. Filter pack shall be added during and following development of the well in accordance with section 2.11.

- C. Developing by combined jetting and surging: The CONTRACTOR shall provide to the ENGINEER specific sequences of development by jetting and/or combined jetting and surging.

Equipment for combined jetting and surging shall include (1) a string of drop pipe (2) necessary hoses, valves, gauges, pipes, etc.; (3) a centrifugal pump; and (4) a surge block similar to that shown on the DRAWINGS.

Also required for development by combined jetting and surging will be a drill rig capable of operating the combined jetting-surging tools at a minimum rate of 8 strokes per minute to a maximum rate of 20 strokes per minute using the drilling action of the rig. Stroke lengths shall be 24 to 36 inches. A surface-mounted pump or pumps capable of discharging up to 360 gallons per minute shall be provided to pump from the well to maintain drawdown during development. The pump shall be equipped with suction hose or pipe of suitable diameter and length and a discharge with valve or engine throttle and a means of measuring discharge.

During combined jetting and surging, each screen interval equal to the surge stroke length shall be covered in a similar manner while jetting and surging.

The development shall be done in a careful and systematic manner to assure complete development without damage to the aquifer or screen. Development shall continue until the sand particles in the pump discharge are reduced to a concentration acceptable to the ENGINEER.

At no time shall both the rotational and vertical movement of the tool be permitted to stop while jetting is underway.

Upon completion of development by combined jetting and surging, the well shall be cleaned of accumulated material. Filter pack shall be added during and following development of the well in accordance with section 2.11.

- D. Developing by Cable Tool Surging: The CONTRACTOR shall provide to the ENGINEER specific sequences of development by cable tool surging. This development method is NOT SUITABLE for a wire wrapped screen casing. If the wire wrapped screen selective alternate option is chosen by the OWNER, cable tool surging will NOT be permitted.

Equipment for cable tool surging shall include: (1) a cable tool surge block as shown on the DRAWINGS and, (2) a cable tool drilling rig capable of generating sufficient rates of upwards lift in a well of this diameter.

During cable tool surging an interval of screen corresponding to the associated cable drilling rig stroke length shall be developed at one time. Each screen interval equal to the stroke length shall be covered in a similar manner.

The development shall be done in a careful and systematic manner to assure complete development without damage to the aquifer or screen. Periodically the well is to be pumped to remove any sediment and check the progress of the well development process. Development shall continue until the sand particles in the pump discharge are reduced to a concentration acceptable to the ENGINEER.

At no time shall the CONTRACTOR allow the velocity of the surge block to put excessive stress on the well screen or casing. Cable tool surging is to take place in the screened section of the well only in order to avoid creating excessive negative pressures within the smooth steel casing.

Upon completion of development by cable tool surging, the well shall be cleaned of accumulated material. Filter pack shall be added during and following development of the well in accordance with section 2.11.

- E. Final Developing by surging and pumping: As directed by the ENGINEER, the well shall be developed by surging and pumping, starting at a low discharge rate, and increasing to the maximum. Pumping and surging shall consist of pumping the water to the surface and shutting off the pump to allow the water to flow back down the column pipe. At the discretion of the CONTRACTOR, the test pumping equipment referenced in section 2.13 may be installed prior to final development and used for surging. Alternatively, an airlift method may be employed at this time.

This shall be done repeatedly with periodic intervals of pumping to remove sand. The surging and pumping shall continue until the discharge is relatively sand free as determined by the ENGINEER. Upon completion of final development, the well shall be cleaned of accumulated material.

- F. Measurement and Payment: Payment for developing the well, will be made at the contract unit price per hour, which unit price shall include all costs of operating the developing equipment and the cost for lowering or raising the equipment into a new position within the well for developing. No payment will be made for time spent maintaining equipment, or for time spent at the surface of the well removing one type of equipment and installing another. The equipment shall include jetting tools, surge blocks, drop pipe strings, fittings, hose and pipe valves, high-pressure jetting pump, pressure gauges, centrifugal pump, drilling rig, and all other equipment necessary for developing the well.

2.13 TEST PUMPING EQUIPMENT

- A. General: The CONTRACTOR shall provide test pumping equipment for the testing of the supply well.

The CONTRACTOR must supply his own engine-generator.

The test pumping equipment shall consist of a pump, column pipe assembly, discharge elbow, water-level observation pipe, tank, pipeline with throttling valve, flow meter, and other miscellaneous equipment, including lighting.

The CONTRACTOR'S test pumping equipment shall be capable of operating for a period of up to 4 days without stopping for maintenance or other reason.

Test pumping of the well will be required immediately following completion and developing of the well unless directed otherwise by the ENGINEER.

Upon completion of all testing, the CONTRACTOR-furnished test pumping equipment shall be removed from the site and shall remain the property of the CONTRACTOR.

- B. Test pump: The test pump shall be a submersible or vertical turbine pump. The pump shall have a capacity range of 1000 to 2000 gallons per minute while pumping from a maximum depth of 205 feet below natural ground surface.

The pump and column pipe shall be adequately supported at the surface of the well. The pump may be supported on either the surface or production casing.

If the test pump is to be used for the final phase of development, as per section 2.12 E, the pump shall not be equipped with a ratchet or other type device which will restrict backspin when the pump is stopped.

- C. Discharge pipeline: A discharge pipeline furnished by the CONTRACTOR shall convey the water away from the well site.

The CONTRACTOR shall provide 500 linear feet of pipeline, which shall have sufficient capacity to convey the highest required discharge of 2000 gallons per minute away from the well site. At the option of the CONTRACTOR, two or more pipelines, each up to 250 feet in length, may be used instead of a single pipeline.

The pipeline joints shall not leak more than 2 gallons per minute at each joint.

The pipeline shall be installed from the new well and shall be located in a direction as approved by the ENGINEER to minimize damage by erosion.

- D. Water-level observation pipe: A 1-inch-diameter or larger metal pipe for measuring water-level drawdown in the well shall be installed at the same time as the pump. The pipe shall extend from near the base of the discharge head to the top of the pump bowls. The lower 5 feet of this pipe shall have a minimum of two ¼-inch drill holes or saw cuts per foot, and the lower end shall have a cap, which shall have a ¼-inch drill hole. The top of the pipe shall be arranged to permit easy access for insertion of a tape or electric probe for measuring depth to the water level during testing.

- E. Miscellaneous equipment: The CONTRACTOR shall provide at least two electric lights with minimum 75-watt rating each for nighttime operations. Also, cribbing or other type support shall be provided to maintain the discharge-throttling valve and measuring equipment in a level, stable position.

- F. Measurement and Payment: Payment for furnishing, installing, and removing test pumping equipment will be made at the contract lump sum price, which unit price shall include all costs of furnishing, installing, and removing the test pump and motor, generator, discharge elbow, discharge tank, discharge pipeline, valve, meter, water-level observation pipe, and miscellaneous equipment. Equipment furnished by the CONTRACTOR shall remain the property of the CONTRACTOR.

2.14 STEP DRAWDOWN AND SUSTAINED YIELD TESTING

- A. General: Following installation of all test pumping equipment, a step drawdown test, followed by a sustained yield test shall be conducted.

Operation of the pumping equipment shall not begin until after the well has been completed and developed as per section 2.12. The CONTRACTOR shall notify the ENGINEER not less than 48 hours in advance of the date and time he/she will be ready to start operation of the test pumping equipment. The date and hour selected shall be a regular day shift, Monday through Friday, excluding holidays.

The CONTRACTOR will be responsible for efficient and reliable operation of the test pumping equipment.

Test pumping shall only be done under the direction of the ENGINEER. An estimated minimum 2 days at the well will be required for the step drawdown test, excluding sustained yield testing.

On completion of all test pumping and removal of test pumping equipment, the well shall be sounded by tape to the bottom. If more than 1 foot of material has accumulated in the bottom, the well shall be bailed or pumped clean using sterilized equipment.

Filter pack shall be added during and following test pumping in accordance with section 2.11.

- C. Preliminary capacity test: Following test pump installation, at the option of the ENGINEER, the augmentation well shall be pumped at rates of discharge as directed by the ENGINEER to determine the limits of the step drawdown test to follow. On completion of the preliminary capacity tests, the well shall be permitted to recover for not less than 8 hours.
- D. Step drawdown test: Based on the apparent capacity of the well during the previous tests, the well shall be tested in three to six successive steps of approximately equal increments (for example, 1000, 1200, 1400, and 1700 gallons per minute and up to 2000 gallons per minute). During each step, the pump discharge shall be maintained at the required rate as directed for periods of up to 2 hours duration.

Should the equipment malfunction for any reason, the test shall be stopped and the well permitted to recover for a period at least 1½ times as long as the test had been in operation. No payment will be made for pumping or well recovery time on an uncompleted test unless the interruption is due to causes over which the CONTRACTOR has no control. Following

completion of a step drawdown test, the well shall be permitted to recover for not less than 1 hour for each hour of test operation, if sustained yield test is required.

- E. Sustained yield test: Following an adequate recovery period from previous testing, a sustained yield test shall be run on the well for a time period as determined by the ENGINEER.

For sustained yield testing at the well, the CONTRACTOR shall continuously operate the pumping equipment at a constant rate of discharge for a period up to 4 days. The rate of discharge will be determined by the ENGINEER.

If failure of the pumping equipment, water disposal pipeline, or similar cause necessitates interruption of the test during the first 72 hours, the CONTRACTOR shall permit the water level to recover to its original position and shall start the test again. All WORK performed prior to such failure shall be at the CONTRACTOR'S expense.

- F. Measurement and Payment: Payment for step drawdown test and for sustained yield test will be made at the contract unit price per hour BID in the schedule for step drawdown and sustained yield testing, which unit price shall include all costs of operating the pumping equipment and bailing or pumping material from the well on completion of testing. Measurement will be made for the actual time the test pump is operated. No payment will be made for an incomplete test caused by malfunctioning of the testing equipment or disposal facilities or for water-level recovery periods between tests.

2.15 RECORDS

The CONTRACTOR shall maintain and provide all RECORDS and forms required by State of Colorado regulations for the well. The RECORDS for the well shall be furnished to the ENGINEER within 10 working days after completion of all WORK on the well, except for test pumping.

Failure by the CONTRACTOR to maintain accurate up-to-date RECORDS shall constitute cause for rejection of the WORK.

Cost: The cost of keeping RECORDS shall be included in the price BID in the schedule for other items of WORK.

2.16 COLD WEATHER DRILLING

- A. If temperatures drop to a level where heating of water and drilling fluid is needed to proceed with the drilling of the well, the CONTRACTOR shall supply and operate an appropriate boiler to heat the fluid. Use of such equipment shall be contingent upon the approval of the ENGINEER.
- B. Costs: The cost of operating a boiler otherwise heating water and drilling fluid shall be included in the prices BID in the schedule for other items of WORK.