stubs shall be covered with mortar and smoothed. Rough, uneven surfaces will not be permitted.

7. Frames and Covers:

Frames and covers shall be ductile iron. Castings shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects, which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar material, will not be permitted. Frames and covers shall be machine finished or ground on seating surfaces so as to assure non-rocking fit in any position and interchangeability of covers. Rings and covers shall be positioned so the hinged lid opens towards oncoming traffic if placed within the roadway or as directed by the City and shall be adjusted to conform to the final finished surface grade of the street or easement to the satisfaction of the City or agent for the City. Manhole frames and covers shall have the City logo on them and shall be ERGO type as manufactured by East Jordan Iron Works, per the City's Standard Details.

C. Side Sewer Lateral

A side sewer lateral is considered to be that portion of a sewer line that will be constructed between a main sewer line and a property line or easement limit line.

All applicable specifications given herein for sewer construction shall be held to apply to side sewer laterals.

Each single-family unit or each unit in a duplex shall have its own connection to the sewer main and shall be a minimum 6-inch-diameter pipe. Side sewers shall be connected to the tee, provided in the sewer main where such is available, utilizing approved fittings or adapters. The side sewer shall rise at a maximum of 45° and a minimum of 2 percent, from the sewer main.

Where there are no basements, the minimum side sewer depth shall be 6 feet below existing curb line and 5 feet below ground at the property line, except where existing improvements, proposed improvements or topography may dictate additional depth. The elevations of the side sewer connections shall be of sufficient depth to serve all existing and potential future basements.

The Contractor shall provide for each 6-inch side sewer service a 12-foot-long 2-inch x 4-inch wooden post, which extends from the invert

of the end of the 6-inch pipe to above the existing ground. The exposed area of this post shall be painted white and shall have 2-inch letters (black paint) "S/S" and shall also indicate the depth of the sewer service stub from finished grade.

Where no tee or wye is provided or available, connection to the sewer main shall be made by machine-made tap and saddle, only with specific written authorization of the City. The City shall review the exact location and material, list in its evaluation.

The maximum bend permissible at any one fitting shall not exceed 45°. The maximum bend of any combination of two adjacent fittings shall not exceed 45° unless straight pipe of not less than 3 feet in length is installed between such adjacent fittings, or unless one of the fittings is a wye branch with a cleanout provided on the straight leg.

D. Private Side Sewers

Private side sewers are the extension of side sewer laterals located outside of the public rights-of-way or easements granted to the City of Granite Falls.

1. Side sewer pipe located on private property shall be 4 inches (larger if specifically approved by the City), ductile iron or PVC ASTM D3034 pipe, and shall be installed at a 2 percent minimum grade. Construction on private property may be performed by owner, but requires a permit and approval by the City. Side sewer slopes on private property of 1 percent may be approved by the City in special circumstances if the side sewer is constructed with no greater than 22-1/2° bends and a minimum of 3 feet between bends.

2. Pipe shall be bedded with pea gravel or clean free draining sand.

3. Side sewer shall be inspected by the City's Representative/Inspector prior to backfilling. Side sewer shall be plugged and tested in the presence of the City Inspector by filling with water. Leakage rate shall not exceed 0.31 gal./hr. for 4-inch pipe and 0.47 gal./hr. for 6-inch pipe, per 100 feet of pipe. The distance of the private side sewer shall be measured from the clean out at the property line to entrance into the building.

4. On private property, minimum cover shall be 18 inches over top of pipe from the point, which is 30 inches out from house and continuing to the connection with the City's sewer system. If this

depth of bury cannot be achieved due to site constraints Class 52 ductile iron pipe shall be used.

5. Parallel water and sewer lines shall be 10 feet apart horizontally wherever possible and have a vertical separation of 18 inches if a vertical crossing is necessary.

6. No more than 100 feet is allowed between cleanouts. Cleanouts are required for bends equal to or greater than 45°. Cleanout shall be a watertight capped gasketed tee or wye lateral. All cleanouts in concrete or asphalt shall have a ductile iron black asphalt coated ring and cover marked "Cleanout" or "Sewer."

7. All pipe joints shall be rubber gasket type.

8. Provide a grease trap/interceptor of a size and type approved by the City at all such locations as may be deemed necessary by the City. The size and design of grease traps and interceptors and hydro-mechanical grease interceptors (HGIs) shall conform to the Uniform Plumbing Code and shall be approved by the City Building Official. Traps and interceptors shall be located on private property outside the building within 20 feet of driveway for access by maintenance vehicles. An HGI may be located inside the building, and shall remain privately owned and maintained at the owner's or occupant's expense. A maintenance program must be submitted and approved that includes maintenance, testing requirements and reporting intervals. These facilities shall be available for the inspection by the Building Official at all times. When pretreatment is no longer required, the inlet and outlet pipes shall be permanently plugged, the separation chambers pumped out, and the vault removed, or filled with compacted crushed rock or controlled density fill.

7.5 TESTING GRAVITY SEWERS FOR ACCEPTANCE

The Contractor and/or Developer shall furnish all facilities and personnel for conducting tests under the observation of the City Engineer or City Inspector.

A. Preparation for Testing for Leakage

The Contractor and/or Developer shall be required, prior to testing, to clean and flush all gravity sewer lines with an approved cleaning ball and clean water. The completed gravity sewer, including side sewer stubs, after completion of backfill and cleaning shall be televised inspected. Ponding greater than 1/2 inch shall not be accepted. This will be

permitted prior to paving. The sewer shall then be tested by the low-pressure air test method and/or an infiltration test but only after all utilities are installed. Except, however, that in certain conditions an exfiltration test may be required by the City Engineer.

The first section of pipe not less than 300 feet in length installed by each crew shall be tested, in order to qualify the crew and/or the material. A successful installation of this first section shall be a prerequisite to further pipe installation by the crew. At the Contractor's option, crew and/or material qualification testing may be performed at any time during the construction process after at least 2 feet of backfill has been placed over the pipe.

Before the test is performed, the pipe installation shall be cleaned. The Contractor shall furnish an inflatable diagonally ribbed rubber ball of a size that will inflate to fit snugly into the pipe to be tested. The ball may, at the option of the Contractor, be used without a tag line, or a rope or cord may be fastened to the ball to enable the Contractor to know and control its position at all times. The ball shall be placed in the last cleanout, or manhole on the pipe to be cleaned, and water shall be introduced behind it.

The ball shall pass through the pipe with only the pressure of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first manhole where its presence is noted. In the event cemented or wedged debris, or a damaged pipe stops the ball, the Contractor and/or Developer shall remove the obstruction, and/or repair any damaged pipe. All visible leaks showing flowing water in pipelines or manholes shall be repaired even if the test results fall within the allowable leakage. The cleaning shall be carried out in such a manner to not infiltrate existing facilities. Precautions shall be taken to prevent any damage caused by cleaning and testing. Any damage resulting shall be repaired by the Contractor and/or Developer at his own expense. The manner and time of testing shall be subject to approval of the Manager and/or the City Engineer.

B. Low-Pressure Air Test

After the installation of the side sewer laterals, the sewer pipe shall be tested for leaks through the use of air in the following manner:

Following the pipe cleaning and televised inspection, the pipe installation shall be tested with low pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water

that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 2.5 pounds per square inch greater than the pipe section's average adjacent groundwater back pressure.

The pipeline shall be considered acceptable if the total time of air loss from any section tested in its entirety between manholes, cleanouts or pipe ends does not exceed the following table:

AIR TESTING PERFORMANCE

Length of 8-Inch Pipe (ft)	Length of 6-Inch Pipe (ft)								
	0	**50**	**100**	**150**	**200**	**250**	**300**	**350**	**400**
0	0	0:40	1:20	1:58	2:38	3:18	3:58	4:38	5:16
50	1:10	1:50	2:30	3:10	3:48	4:28	5:08	5:48	5:56
100	2:20	3:00	3:40	4:20	5:00	5:38	6:14	6:12	6:08
150	3:32	4:10	4:50	5:30	6:10	6:30	6:26	6:22	6:18
200	4:42	5:22	6:00	6:40	6:44	6:38	6:34	6:30	6:26
250	5:52	6:32	6:48	6:58	6:50	6:44	6:40	6:36	6:32
300	7:02	7:20	7:10	7:02	6:56	6:50	6:44	6:40	6:36
350	7:34	7:22	7:14	7:06	7:00	6:54	6:50	6:44	6:42
400	7:34	7:24	7:16	7:08	7:02	6:58	6:52	6:48	6:44

*Test time in minutes and seconds

Test times will be provided by the City Engineer upon request for combinations other than 8-inch mains and 6-inch laterals.

If the pipe installation fails to meet these requirements, the Developer and/or Contractor shall determine at his own expense the source or sources of leakage, and he shall repair (if the extent and type of repairs proposed by the Developer and/or Contractor appear reasonable to the City Engineer) or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of this low-pressure air test or the alternative water exfiltration test before being considered for acceptance.

Caps used to close the sewer pipe and side sewer laterals for the air test shall be securely braced to prevent the unintentional release of a cap, which can become a high velocity projectile. Gauges, air piping manifolds and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Air testing apparatus shall be equipped with a pressure release

device such as a rupture disk or a pressure relief valve designed to relieve pressure on the pipe under test at 6 psi.

C. Exfiltration (Water) Test (if approved by City)

The Contractor shall provide a groundwater observation well at each manhole for determining the level of the groundwater during the test. The observation well shall consist of 1-inch plastic pipe installed vertically adjacent to the manhole. The lower end of the test well shall be placed in a 1 cubic yard pocket of washed gravel and shall be at the same elevation as the invert of the manhole. The upper end of the test well shall be terminated within 2 feet of the finished grade elevation and shall be plugged and exposed until completion of the test.

All pipe shall be cleaned before the exfiltration test. Prior to making exfiltration leakage tests, the Developer and/or Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls; provided however, that after so filling the pipe he shall complete the leakage test within 24 hours after filling. When under test, the leakage allowable shall comply with the provisions that follow:

Leakage shall be no more than 0.15 gallons per hour per inch of diameter per 100 feet of sewer pipe, with a minimum test pressure of 6 feet of water column above the crown at the upper end of the pipe or above the active groundwater table, whichever is higher as determined by the City. The length of pipe tested shall be limited so that the pressure on the invert of the lower end of the section tested shall not exceed 16 feet of water column. For each increase in pressure of 2 feet above a basic 6 feet measured above the crown at the lower end of the test station, the allowable leakage shall be increased by 10 percent.

The Developer and/or Contractor shall furnish all equipment, materials, and labor necessary for making test. The equipment shall be to the approval of the City Manager and/or City Engineer. The manner and time of testing shall be subject to approval of the City Engineer. It shall be the Developer's and/or Contractor's responsibility to determine the level of the water table at each manhole. If leakage exceeds the allowable amount, corrective measures shall be taken and the line then be retested to the satisfaction of the City's designated inspector.

D. Deflection Test

Deflection tests shall be performed on all ASTM D3034 PVC gravity sewer mains by pulling a mandrel through the pipe. The allowable deflection test limit shall be 5.0 percent of the base inside diameter in

accordance with APWA test procedures and the nominal mandrel size shown in the following table.

Nominal Pipe Size (in.)	Base Inside Diameter (in.)	Mandrel Size, Diameter (in.)
6	5.74	5.45
8	7.67	7.28
10	9.56	9.08
12	11.36	10.79

The sewer lines shall be thoroughly cleaned prior to the deflection test.

E. Testing Force Main

Force main shall be tested using the same procedures as water lines.

F. Vacuum Testing of Precast Manholes

Vacuum testing (negative air pressure) may be required by the City in areas of high groundwater. Prior to backfilling, each manhole shall be tested using the vacuum testing method specified in ASTM C1244 to ensure that the manhole is watertight. Testing of manholes constructed on existing sewer lines where flow must be maintained will not be required.

Backfilling of the manhole prior to testing is permitted.

The Contractor shall furnish all equipment and labor required, including necessary piping/hoses, pneumatic plugs, test vacuum equipment (vacuum pump and vacuum plate/head), vacuum gauge, and second timer. The vacuum gauge shall have a maximum range of 0-30 inches of mercury (Hg) and the vacuum gauge intervals shall be in 1/2-inch increments.

The vacuum test shall be performed by the Contractor in the presence of City personnel. The Contractor shall furnish test reports of each test to the Engineer.

G. Testing

If a coating or lining has been applied to the interior of the manhole, the vacuum test must not be performed until the coating or lining has been cured according to the manufacturer's recommendations. In addition, this existing manhole must be structurally sound prior to vacuum testing.

Drop connections shall be installed prior to testing.

The vacuum test shall include testing of the seal between the cast iron frame and the concrete cone, slab, or grade rings.

After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all the connecting pipes with the exception of sewer services to isolate the manhole. Complete sewer services entering the manhole shall be a part of the manhole vacuum test.

The vacuum plate/head shall be placed on top of the manhole lid frame. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury has been attained, the vacuum pump shall be shut off. With the outlet valve closed, the time shall be measured for the vacuum to drop to 9 inches. Following are the **minimum** allowable test times for manhole acceptance at the specified vacuum drop:

Depth of Manhole (feet)	**Time (Seconds)**		
	48-Inch Dia.	**60-Inch Dia.**	**72-Inch Dia.**
4	10	13	16
8	20	26	33
12	30	39	49
16	40	52	67
20	50	65	81
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
Add for each additional 2 feet of depth	5	6.66	8

Source: ASTM C1244

All pneumatic plugs shall be removed from the manhole after the test.

H. Failure

Any manhole that fails the initial vacuum test must be repaired with an approved non-shrink grout material for manholes. The Contractor shall excavate the manhole and apply non-shrink grout on the interior and exterior of the manhole in the leaking area or the entire surfaces. Any repair between the pipes and the manhole (gasket waterstop area) requires the removal of the pipe by means of coring and the installation of a new pipe with waterstop (grouting the annular opening). Upon completion of

the repairs, the manhole shall be retested as described in the above test procedures.

Any manhole that ultimately fails the vacuum test is rejected and shall be entirely removed and replaced with a new manhole. The new manhole shall not be backfilled until it has been tested and passed the above test procedures.

I. Acceptance

The manhole shall have passed the vacuum test if the manhole vacuum does not drop below 9 inches of mercury during the minimum specified test period.

7.6 VIDEOTAPING

After the gravity sewer lines have been cleaned, flushed and manhole channeled, the Developer shall provide a complete televised inspection.

The Developer shall perform a complete televised inspection of the sewer pipe and appurtenances and shall provide to the City, a DVD color audio-visual recording of the inspections together with a written log of the television inspection. The camera shall be a pan and tilt type equipped with adequate light and focusing to allow inspection of sewer main, side sewers and full circumference inspection of main line joints and fittings. The City shall determine if the quality of the televising is acceptable.

Immediately prior to the televised inspection, the Developer shall run water through each sewer line for 5 to 10 minutes to provide water for detection of any adverse grade sections visible by the presence of ponded water. If ponded water is observed the camera shall be stopped periodically at the ponded areas and the depth of water shall be measured with a ball of known diameter on the pull line. Ponding greater than 1/2 inch shall not be accepted. During the inspection, all tees and other fittings shall be logged as to exact location within 1 percent maximum error in measurement.

The City shall be notified 48 hours prior to any television inspection and this work shall be performed on a schedule to allow the City to witness the inspection.

Any defects in material or installation identified by the television inspection shall be repaired as required by the City at the Developer's expense.

7.7 STATE HIGHWAY CROSSINGS

All state highway crossings shall be completed with a steel casing and a ductile iron or HDPE carrier pipe, as approved by the City and prevailing regulatory agencies. The welded steel casing shall be of sufficient diameter, size and strength to enclose the sewer pipe and to withstand maximum highway or railroad loading. Sizing and wall thickness of casing is subject to approval by the City Engineer. Sand backfill or grout fill between the casing and the sewer pipe shall be required. The sewer pipe shall be restrained joint or continuous welded pipe within the casing pipe. In order to prevent the sand from being washed from the casing the ends of the casing shall be bricked and cemented after installation, backfill and testing of the pipe are completed.

7.8 STREET PATCHING AND RESTORATION

See Sections 5.15, 5.16 and 5.17 for requirements regarding street patching, trench restoration, and surfacing requirements.

7.9 ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO GRADE

This work consists of constructing and/or adjusting all new and existing utility structures encountered on the project to finished grade.

A. Asphalt Concrete Paving Projects

On asphalt concrete paving projects, the manholes shall not be adjusted until the pavement is completed, at which time the center of each manhole lid shall be relocated from references previously established by the Developer and/or Contractor. The pavement shall be cut as further described and base material removed to permit removal of the cover. The manhole shall then be brought to proper grade.

Prior to commencing adjustment, a plywood and visqueen cover as approved by the City Inspector shall be placed over the manhole base and channel to protect them from debris.

As soon as the street is paved past each manhole, the asphalt concrete mat shall be scored around the location of the manhole, catch basin, meter boxes or valve box. After rolling has been completed and the mat has cooled, it shall be cut along the scored lines, the diameter of which shall not exceed 48 inches or 14 inches from the outside diameter of the ductile iron frame, whichever is smaller. The ductile iron frame shall be brought up to desired grade, which shall conform to surrounding road surface.

Adjustment to desired grade shall be made with the use of concrete or bricks. No cast or ductile iron adjustment rings will be allowed. An approved class or mortar (one part cement to two parts of plaster sand) shall be placed between manhole sections; adjustment rings or bricks and ductile iron frame to completely fill all voids and to provide a watertight seal. No rough or uneven surfaces will be permitted inside or out. Adjustment rings or brick shall be placed and aligned so as to provide vertical sides and vertical alignment of manhole steps and ladder.

Check manhole specifications for minimum and maximum manhole adjustment and step requirements. Special care shall be exercised in all operations in order not to damage the manhole, frames and lids or other existing facilities.

The manholes, catch basins, meter boxes and valve boxes shall be raised to finished pavement grade and the annular spaces filled with hot mix asphalt concrete (PG 58H-22) to give a smooth finished appearance. See detail in Project Plans.

After pavement is in place, all joints shall be sealed with hot asphalt cement (AR 4000W). A sand blanket shall be applied to the surface of the AR 4000W hot asphalt cement binder to help alleviate "tracking."

Asphalt concrete patching shall not be carried out during wet ground conditions or when the ambient air temperature is below 50 degrees F. Asphalt concrete mix shall be at required temperature when placed. Before making the asphalt concrete repair, the edges of the existing asphalt concrete pavement and the outer edge of the casting shall be tack coated with hot asphalt cement. The remaining 2 inches shall then be filled with hot mix asphalt concrete and compacted.

The completed patch shall match the existing paved surface for texture, density and uniformity of grade. The joint between the patch and the existing pavement shall then be carefully painted with hot asphalt cement or asphalt emulsion and shall be immediately covered with dry paving sand before asphalt cement solidifies. All debris such as asphalt pavement, cement bags, etc., shall be removed and disposed of by the Developer and/or his Contractor.

Prior to acceptance of a project, manholes shall be cleaned of all debris and foreign material. All manhole steps and ladders shall be cleaned free of grout. Any damage occurring to the existing facilities due to the Developer's and/or Contractor's operations shall be repaired at his/her own expense.

B. Adjustment of Manholes in Easements

Manholes in easement areas shall be adjusted to insure drainage away from the manhole frame and cover. The manhole frame and cover shall be set approximately 0.1 foot above finished grade. Concrete pad shall be set about the structure, as detailed herein, in all non-paved areas.

C. Adjustment of Valve Box Castings

Adjustment of valve box castings (force main valving) shall be made in the same manner as for manholes.