

**CITY OF LONGMONT
SECTION 400 - WASTEWATER COLLECTION
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**SECTION 400 - WASTEWATER COLLECTION
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WASTEWATER COLLECTION

400.00 MINIMUM DESIGN CRITERIA

400.01 GENERAL

1. All Wastewater collection systems will comply with the requirements of the Standards and Specifications for sanitary sewer and service line construction and may include criteria established by the Engineer for the overall hydraulics of the wastewater utility system. Other criteria may be outlined in PIP as determined by the Engineer.
2. Design and planning criteria shall be in conformance with the City's Wastewater Master Plan (W.W.M.P.), as amended.
3. These standards and specifications apply to pipe sizes up to and including fifteen (15) inches in diameter. Sizes larger than fifteen (15) inches shall be as determined by the Engineer on a project by project basis.
4. Groundwater barriers or other precautions may be required by the Engineer in trenches which are below the groundwater table.
5. Sewer interceptors (pipes larger than twelve (12) inch diameter) will have flows no greater than a ratio of 1.0 of flow depth to pipe diameter (d/D)¹.

400.02 QUANTITY OF WASTEWATER

1. Residential wastewater flows will be determined by using an average daily flow of seventy five (75) gallons per person per day and averaging 2.2 persons per dwelling unit. Industrial and commercial area flows will be determined using 1833 gallons per day per acre, unless actual data is given that exceeds the above figures.
2. Design shall be based upon peak daily flows found by using peaking factors as noted below or as determined by the Engineer. These factors may differ throughout the City. Design flow shall be the sum of the peak flow and the flow due to infiltration and inflow.

Total peak flow, Q_t , mgd shall be as determined by the following formula, in accordance with the Wastewater Master Plan.

$$Q_t, \text{mgd} = \frac{\left[\frac{3.54}{\left[\frac{\sum (Q_a \times A_n)}{1,000,000} \right]^{0.168}} \right] \times \sum (Q_a \times A_n) + Q_a 7 \times A_7 + (Q_b + Q_c) \times A}{1,000,000}$$

where: A, in acres = sum of the individual land use areas, $\sum (Q_a \times A_n)$ in gpd = the sum of six individual calculations where the area, A_n , within each of six land use

¹ Quality of Life Benchmark

categories is multiplied by the average daily base sewage flow, Q_a , that corresponds to that land use category.

For example,

$$\text{SUM } (Q_a \cdot A_n) = Q_{a1} \cdot A_1 + Q_{a2} \cdot A_2 + Q_{a3} \cdot A_3 + Q_{a4} \cdot A_4 + Q_{a5} \cdot A_5 + Q_{a6} \cdot A_6$$

Q_b , in gpd/acre = design infiltration rate.

Q_c , in gpd/acre = design inflow rate.

In accordance with the INTERC computer model, flow from the open space land-use category and inflow and infiltration is not peaked and is not included in the term $\text{SUM } (Q_a \cdot A_n)$. Also note that all $Q \cdot A$ calculations are done for both existing and future areas and the corresponding base sewage flows are added together prior to application of the peaking factor.

3. Final design to include calculations based upon projected or actual usage, whichever is higher.

400.03 DESIGN VELOCITIES AND GRADES

1. All sanitary sewers shall be designed to insure that the peak day flows velocities within the pipe will be two (2) feet per second as a minimum and ten (10) feet per second as a maximum. The minimum and the maximum grades of the sewer lines shall be as follows:

Pipe Diameter (inches)	Minimum Slope (%)	Maximum Slope (%)
8	0.40	7.5
10	0.25	5.5
12	0.20	4.5

1. Sanitary Sewer mains constructed under these Standards and Specifications shall be designed so as to adequately serve the entire area when fully developed. The minimum allowable size for a main is eight (8) inch diameter. The Engineer reserves the right to resize any sewer main that is inadequate for the proposed use, based on standard engineering practices.

400.05 SERVICE LINE SIZES AND GRADES

1. Service lines shall be designed with a minimum fall of one quarter (1/4) inch per foot, (2%), and a maximum velocity of ten (10) feet per second. In the event that site conditions do not allow a 2% slope, the Engineer may grant a variance to the minimum slope requirements. The minimum allowable service line size is four (4) inches, any building requiring larger than a four inch service shall be sized by the Design Engineer based on standard engineering practices. All service line sizes will be subject to review and approval of the Engineer.

400.06 DEPTH

1. Unless otherwise approved by the Engineer because of site specific conditions, sanitary sewer mains should be designed deep enough to accommodate service line installations and a maximum cover of fifteen (15) feet. Without exceeding maximum flow velocities, service lines shall be a maximum of ten (10) feet deep at the back of walk.

400.07 ALIGNMENT

1. Sewer mains shall be laid whenever possible at the center line of the street. Sewer mains shall be located a minimum of ten (10) feet horizontally from existing or proposed water mains (edge to edge distance) and shall be located a minimum of five (5) feet horizontally from lip of gutter. No sewer mains shall be installed within fifteen (15) feet of any existing building, retaining wall, or structure unless approved by the Engineer. No structure or retaining wall shall be constructed within a minimum of fifteen (15) feet from any sewer main unless approved by the Engineer. All weather vehicular access shall be provided to manholes and valve boxes installed in areas outside of the public roadway. This shall consist of a minimum ten (10) foot wide gravel, asphalt, or concrete path or roadway constructed to the thicknesses shown in the standard City details with a minimum fifty five (55) foot center line radius on curves. If there is a water and sanitary sewer crossing, the requirements of these standards and specifications must be followed (refer to General section 107.09 " Utility Line Crossing").

400.08 FUTURE EXTENSION OF MAINS

1. When a sewer line under construction is anticipated to be extended at a future date, the end of the line shall have a manhole and a plugged stub out installed in the direction(s) of future extension. Sanitary sewers must be extended to the far edge of the property to be serviced, or to the edge of the platted subdivision or as directed by the Engineer. All extension lengths shall be subject to the approval of the Engineer. When a sewer line is not to be extended at some future date, the line being installed shall extend a minimum of ten (10) feet into the last property to be served and a manhole shall be installed. No services shall be placed on an extension of the upstream side of a manhole.

400.09 MANHOLE SIZE AND SPACING

1. Manholes should be located at all changes in grade, size and alignment. For changes in pipe size, the crowns of the pipes shall be at the same elevation, or the drop across the manhole between the incoming and outgoing flow shall be 0.2 feet whichever is greater. No curved sewer pipe may be used. Manholes shall be located at street intersections whenever possible.
2. Manholes are to be four (4) foot in diameter for pipe up to and including fifteen (15) inches, larger pipe or multiple large pipes may require manholes with a five (5) foot diameter or larger. See Detail 400-01.
3. Manholes must be spaced no farther than four hundred (400) feet apart, unless approved by the Engineer.

4. Manholes should be located in areas which are not subject to flooding from surface runoff. No manholes may be located in areas where ponding or storm detention basins are to be used.
5. Manholes must be located in areas which allow direct, all-weather, vehicular access for maintenance vehicles.
6. If the possibility of surface runoff cannot be avoided, a solid manhole cover, having an integral O-ring type gasket and a waterproof insert that can be bolted closed, must be used.
7. All manholes located outside dedicated street rights-of-way and/or within the one-100 year flood plain shall be designed and constructed with a watertight, bolted type cover and the manhole ring shall be bolted to the manhole cone.
8. When a tree invert is constructed, the invert coming into the straight through channel must be at least two tenths (0.2) of a foot higher than the out invert.
9. A 0.10 feet drop between the inverts may be used when the sewer flows straight through the manhole without any bends or branches.

400.10 ABANDONMENT OF EXISTING SEWER LINES OR "STUBS"

1. All four (4) inch sewer service lines that were installed and will not be used shall be abandoned at or near the property line. In certain cases, abandonment at the main may be requested by the Contractor or may be required by the Engineer. This shall include excavating the line and installing a concrete or P.V.C. plug in the line, tap or wye. Abandonment of a sewer service line at the main, must occur prior to final lift paving.
2. All sewer lines that were installed and will not be used that tie directly into a manhole, either main lines or service lines and regardless of size, shall be abandoned at the manhole. These shall be plugged with concrete inside the manhole.

400.11 SETTLING TANKS AND GRIT/GREASE TRAPS

1. The installation of settling tanks and grit and grease traps will be required under the provisions outlined in Section 14.08.415 of the Longmont Municipal Code.
2. All settling tanks and grit and grease traps shall be designed, installed, operated, and maintained in accordance with the requirements set forth in Section 14.08.416 of the Longmont Municipal Code.

410.00 MATERIALS

1. For a specific list of materials accepted by the City Water/Wastewater Department see APPROVED MATERIALS LIST. A copy of the APPROVED MATERIALS LIST can be obtained from the Water/Wastewater Department.

411.00 POLYVINYL CHLORIDE PIPE (P.V.C.)

411.01 DESCRIPTION OF PIPE

1. All PVC pipe sizes four (4) inch through fifteen (15) inch shall meet the requirements of ASTM D3034 "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings", sizes eighteen (18) inch through twenty-seven (27) inch shall meet the requirements of ASTM F-679.

411.02 CLASS AND TYPE

1. All sizes of PVC pipe shall be SDR 35, and shall have the A.S.T.M. Specification, nominal diameter, and name or trade mark of the manufacturer imprinted on the outside of the pipe.

411.03 PIPE LENGTHS

1. Pipe sections will be furnished in lengths of twelve and one-half (12 ½) feet except service tees and closure pieces.

411.04 JOINT TYPE

1. Except as may be authorized by the Engineer, pipe joint assemblies shall be bell and spigot push-on joints using elastomeric gaskets with an O-ring rubber gasket conforming to ASTM F477. Joints shall conform to ASTM D 3212. Solvent cement joints are strictly prohibited.

411.05 PIPE BARREL DIAMETER DEFLECTION

1. The diameter indicated on the Drawings shall mean the inside diameter of the pipe.
2. Test each reach of sewer pipe between manholes for vertical ring deflection after backfill has been completed.
3. Pipe shall be constructed so that the maximum initial vertical diameter does not decrease by more than 5% of the base internal diameter.
4. The maximum allowable deflection at the time of City Final Acceptance of the line shall be 7½% of the base internal diameter. The contractor shall uncover and repair sections exceeding the maximum allowable deflections.
5. Mandrel outside diameters in inches are as follows:

PIPE SIZE	BASE I.D.	5% DEFLECTION	7½% DEFLECTION
MANDREL		MANDREL	
6	5.742	5.455	5.311
8	7.665	7.282	7.090
10	9.563	9.085	8.846
12	11.361	10.793	10.509
15	13.898	13.203	12.856

6. The contractor shall uncover all pipe sections exceeding the above maximum allowable deflections and replace the bedding and backfill to prevent excessive deflection. Retest repaired sections.

411.06 PIPE QUALITY

1. In addition to any deficiencies covered by D3034, PVC which has any of the following visual defects will not be accepted.
 - a. Straight pipe, measured from the concave side, shall not deviate from straight greater than 1/16 inch per foot of length.
 - b. Pipe which is sufficiently out-of-round to prohibit proper jointing.
 - c. Improperly formed bell and spigot ends.
 - d. Fractured, cracked, chipped, or otherwise sufficiently damaged pipe.
 - e. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.

412.00 DUCTILE IRON PIPE

412.01 DESCRIPTION

1. Pipe shall be ductile iron, Class 50, double thickness cement lined or polylined, designed in accordance with AWWA C-151, C-150. Fittings shall be cast iron pipe.

412.02 JOINT TYPE

1. Whenever ductile iron pipe is to be used, the joints shall be mechanical joint or push-on joint unless authorized by the Engineer.

412.03 CORROSION PROTECTION

1. Reference the water section of these Standards for requirements on Corrosion Protection.

413.00 VITRIFIED CLAY PIPE

413.01 DESCRIPTION

1. The installation of vitrified clay pipe is not permitted.

414.00 ASBESTOS CEMENT PIPE (A.C.P.)

414.01 DESCRIPTION

1. The installation of Asbestos Cement Pipe is not permitted.

415.00 FITTINGS FOR SEWER PIPE

1. Fittings used in new sewer construction, unless authorized by the Engineer, shall be of the same material and class as the pipe to which it is attached.
2. Transitions between dissimilar pipe materials shall be approved by the Engineer.

416.00 CLEAN-OUTS IN SERVICE LINES

1. All clean-outs will be P.V.C. or cast iron pipe. Clean-outs shall be placed two (2) feet outside of the structure and at a maximum of one hundred feet apart and at each change in direction of one hundred and thirty five degrees or greater as per the I.P.C. If the clean-out conflicts with structures it can be placed in alternate locations conforming to specific site conditions. Clean-outs in traffic areas shall be cast iron and be designed to carry the appropriate weight loads without damage to the pipe or clean-out.

417.00 UNDERDRAINS

1. Under drains placed next to sanitary sewer mains shall be solid walled rigid pipe. Refer to the Municipal Code for under drain requirements.
2. Under drains are not a part of the sanitary sewer system and they shall not connect to the system at any time.

418.00 MANHOLES

418.01 DESCRIPTION

1. All manholes shall be constructed using precast concrete sections fabricated from type II cement and otherwise conforming to C-478. Manhole steps shall be polypropylene meeting the following requirements. They shall be Grade 60 steel-reinforced, corrosion-resistant polypropylene plastic conforming to ASTM C478. They shall be fabricated with positive-friction lock system for being hand driven by hammer into preformed holes. Manhole cones shall be of the eccentric type. See Detail 400-01.

418.02 MISCELLANEOUS MATERIALS

1. Mortar; non-shrink, non-metallic grout; and preformed plastic gaskets shall be in accordance with the approved material list.

418.03 CASTINGS

1. All castings for manhole heads, covers and frames and for other purposes must be of rough gray iron, and have a workman like finish free from blow-holes. Manhole frames and covers shall be as indicated on the APPROVED MATERIALS LIST.

419.00 CONCRETE AND REINFORCING STEEL

1. All concrete unless otherwise specified on the plans shall use type II cement and have a minimum compressive strength of 4000 p.s.i. in twenty-eight (28) days. The concrete design mix will be subject to the Engineer's approval. An air entraining agent must be

used in all concrete. Metal reinforcement shall be deformed steel bars sized according to their application by the Design Engineer, subject to the approval of the Engineer. All steel reinforcement shall Conform to ASTM A615, Grade 60.

420.00 PLUGS OR STOPPERS

1. Water-tight P.V.C. plugs or stoppers shall be furnished for all temporary or permanent stub-outs and all unused branch pipes. The size of the stopper shall be determined by the size of the pipe in which it is installed.

430.00 CONSTRUCTION INFORMATION

432.00 CONNECTION TO THE EXISTING SYSTEM

1. The physical connection to the existing sewer system shall be plugged until a construction acceptance has been issued for the project. If improper construction methods or materials are used, or excess infiltration occurs, the Engineer may require the sewer be plugged until satisfactory corrections are made. Forty-eight (48) hours notice must be given to the Inspector prior to any connection to the existing system.

433.00 TAPPING

1. No one is permitted to tap the existing sewer system, except Water/Wastewater Department personnel. Where tapping is necessary, the Contractor shall apply for the tap and pay the prevailing fee. The only size tap directly allowed on a sanitary sewer pipe in accordance with the City of Longmont Municipal Codes, is four (4") inch. Any larger size line must be brought into the City System through a manhole.
2. Taps will be scheduled when the Water/Wastewater Operations and Maintenance Division is contacted by the Contractor. No tap will be scheduled less than 48 hours, or two working days, from the time the Water/Wastewater Operations and Maintenance Division is contacted for the tap. No tap will be scheduled until all fees have been paid.
3. When the tapping crew arrives at the site, they will inspect the preparation of the trench for safety, as defined by current O.S.H.A. Standards.
4. The pipe must be sufficiently exposed to accommodate the tapping equipment.
5. When all conditions are deemed safe as described in Paragraph three and four (3 & 4), Water/Wastewater personnel will physically make the tap(s).
6. If the conditions of Paragraph three and four (3 & 4) are not satisfied, the Water/Wastewater personnel will not perform the tap and a new time will have to be scheduled.
7. If rescheduling is necessary due to the fault of the Contractor, all costs for time lost on the originally scheduled tap may be billed to the Contractor.
8. Taps are only made Monday through Thursday and until 12:00 p.m. (noon) on Fridays.

434.00 GENERAL PIPE INSTALLATION

434.01 LOWERING OF PIPE AND ACCESSORIES INTO TRENCH

1. All pipe, fittings, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean by means approved by the Engineer during and after installation.

434.02 INSTALLATION OF PIPE

1. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in line. The end of the pipe will be plugged or capped with approved materials when work stops. Pipe shall be installed working downstream to upstream with the bell end facing upgrade. All pipe installed must be to the required line and grade and checked to insure there is no variation from that line and grade. No pipe shall be laid when, in the opinion of the Engineer or the Inspector, trench conditions are unsuitable, such as unstable bedding, pipe subgrade, or trench walls or the presence of contaminated soil or liquids.

434.03 CUTTING OF PIPE

1. The cutting of pipe for inserting into fittings, shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end with beveled edges recut to match the original pipe. Flame cutting of ductile pipe shall not be allowed. Asbestos cement pipe shall not be cut. An entire section of pipe shall be removed and replaced with a nonasbestos type pipe.

434.04 JOINING OF PIPE

1. Push on and mechanical joints shall be accomplished in accordance with the manufacturer's recommendations.

434.05 JOINT DEFLECTION

1. Sewer pipe shall not have any deflections. All pipe shall be laid and maintained to the required lines and grades. No deviation shall be made from the required line or grade except with the written consent of the Engineer. Manholes and other necessary appurtenances shall be at the required locations. All pipe shall be laid to the depth shown on the construction drawings or as directed by the Engineer in writing.

435.00 SERVICE LINES

1. Each structure and each subdivided lot shall be served by a separate service line. No compound taps are allowed in the City as per City ordinance Section 14.08.230.
2. It is the responsibility of the owner of the premises to service and maintain the service line from the structure to the connection in the main.

3. Sewer service lines shall not be installed in trenches containing conduits which carry potable water without written permission of the Engineer, service lines shall be separated laterally from conduits which contain potable water by a minimum of ten (10) feet edge to edge.

Exception: For water and sanitary sewer services, where it is not possible to achieve a ten (10) foot separation of the water and sewer services due to the size, location or other physical restraints of the lot, the Engineer may allow deviation on a case-by-case basis if supported by data from the design engineer. Such deviation may allow installation of the water service closer to the sanitary sewer, provided the water service is laid in a separate trench or on an undisturbed earth bench located on one side of the trench at such an elevation that the bottom of the water service is at least (eighteen) 18 inches above the top of the sewer.

4. All service lines must be inspected by the Inspector. It is the responsibility of the Contractor or developer to provide to the City as-built drawings indicating actual locations of all service stubs, prior to the issuance of a final acceptance.
5. Sanitary sewer service rehabilitation work will require that a forty eight (48) hour notification be given to the City prior to commencing work. All rehabilitation work on sanitary sewer services must be inspected by the City.
6. All six (6) inch or larger sewer service connections into manholes shall channel their influent to flow with the main stream at no greater angle than 45 degrees with a minimum drop of a 0.2' and a maximum drop of eighteen (18) inches without a drop manhole. Service line drops within manholes will not be allowed.
7. Service line bedding, trench backfill, and compaction shall be the same as for the mainline sewer.
8. All services smaller than six (6) inches must connect into a sewer main.

438.00 SETTING OF MANHOLES AND FITTINGS

438.01 MANHOLES

1. Manholes shall be constructed of concrete in accordance with the Standard Details. The materials, operations, excavation, and backfilling shall conform to the applicable sections of these Specifications.

438.02 BASES

1. Contractor may provide cast in place manhole inverts or precast manhole inverts at Contractor's option. In case of any change in alignment or elevation of manholes Contractor is responsible for making all changes to the approval of the Engineer.
2. All cast-in-place concrete bases for manholes shall be constructed such that they are level conforming to the dimensions as shown on the standard details. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. These must be formed directly in the concrete of the base, or for a straight through

manhole with no other inlets the channel may be constructed by laying full section sewer pipe through the manhole and by cutting out the top half of the pipe after the surrounding concrete has hardened. Changes in direction of flow shall be made with a smooth curve having as large a radius as the manhole will permit. Manhole bases shall be thoroughly bonded to the barrel of the pipe. Provide a rubber water-stop on pipe barrel for PVC pipe. All connections with pipe shall be made without projections or voids. The pipe shall not penetrate more than two inches (2") beyond the interior wall. See Standard Details. Inverts must meet the requirements of the Engineer.

3. All precast concrete bases for manholes shall be constructed level with the precast base and first barrel section monolithic, conformance ASTM C478, Type II cement. The pipe penetration gaskets shall be as specified in the approved material list. No modification of precast sections will be permitted on the job site, all such fabrication must be accomplished at the point of manufacture. Have manufacturer cut openings to receive entering pipes of sufficient size to provide 3/4 inch annular space around pipe or as required by manufacturer of penetration gaskets. Invert within the precast base shall have the same requirements as the invert for the cast-in-place manhole bases.
4. Pipe size changes shall be accomplished by matching pipe crowns and forming the channel to accommodate the pipe size differential. The floor of the manhole outside of the channels shall be smooth and shall slope toward the channels at not less than one (1) inch per foot.

438.03 PIPE CONNECTIONS

1. Manholes shall be thoroughly bonded to the barrel of the pipe. Provide a rubber gasket on pipe barrel for PVC pipe. All connections with pipe shall be made without projections or voids. Where shown on the plans a piece of pipe of the proper size shall be built into the manhole where future laterals may be connected. This pipe shall be sealed with a plug or stopper at its outer end and an invert shall be built into each manhole for such lateral connections.

438.04 DROP MANHOLES

1. No outside drop manholes will be allowed. Inside drop manholes, if necessary, shall be constructed in accordance with Detail 400-05.

438.05 MANHOLE STEPS

1. Manholes shall be provided with polypropylene coated reinforced steps not less than fifteen (15) inches in width, built into or thoroughly anchored in the walls at the time of fabrication or installation (See Section 418.01). No steps shall be installed in the grade rings. These steps shall be positioned, as shown on the standard details. Steps or rungs shall not be required unless the depth of manhole from ring to invert exceeds three (3) feet. Steps shall be vertically plumb. See Detail 400-01.

438.06 PRECAST MANHOLES

1. All precast cones shall be of the eccentric type. Precast sections conforming to section 418.01 shall be placed on the manhole base, after it has reached sufficient compressive strength. No modification of precast sections will be permitted on the job site, all such

fabrication must be accomplished at the point of manufacture. The manhole base shall be thoroughly cleaned, to prepare for the placing of the precast sections. Preformed plastic gaskets or approved equal, or a full mortar bed at least one (1) inch thick is to be applied to the precast section bearing seat. The first precast section shall be carefully lowered onto the base so that the preformed plastic gaskets or mortar is evenly seated on all sides. The interior side of the first, and if deemed necessary by the Inspector, other joints shall be grouted with a nonshrink grout. Each succeeding precast section shall be jointed in a similar manner. See Detail 400-01.

2. In areas where the manhole will be exposed to groundwater, damp-proofing shall be provided consisting of an approved waterproofing applied to the thicknesses and recommendations of the manufacturer. The waterproofing shall only be applied to clean surfaces free of oils, greases, and foreign matters and shall not be placed on surfaces when the ambient air temperature is less than 50 degrees Fahrenheit, unless approved by the manufacturer. See the APPROVED MATERIALS LIST. A copy of the APPROVED MATERIALS LIST can be obtained from the Water/Wastewater Department.

438.07 RAISING MANHOLES

1. Manhole frames shall be raised using precast reinforced concrete rings or cast in place concrete; No other material will be allowed. The first step will be no lower than twenty-four inches (24") from the finished grade of the street. Drop-in type risers are not allowed for new construction. Drop-in type risers may be used on rehabilitation or overlay projects, but only one riser may be used and it shall not exceed 4 inches in height. No steps are allowed on the riser section. See Detail 400-02.

439.00 TESTING

439.01 INFILTRATION TESTING

1. After the compaction of fill material has been completed, tested, and approved, the contractor will check for infiltration and exfiltration in the main. This check will begin at the furthest upgrade end of the system and proceed downgrade in the main from section to section. A section shall be defined as any portion of installed sewer line between two adjacent manholes.
2. Conduct infiltration tests where groundwater is 5 feet or more above the top of the sewer pipe at any point in the sewer trench. If groundwater is less than 5 feet above the top of the pipe, conduct air testing.
3. Conduct test by placing a calibrated V-notched weir in the line as it enters the manhole and plugging the line as it enters the higher manhole. Allow sufficient time for the water level behind the weir to stabilize before reading. Remove any foreign matter hanging on the weir being read. Take successive readings until consistent results are obtained.
4. No visible infiltration is allowed.

439.02 AIR TESTING

1. The air test shall be made when the sewer is clean. The pipe, or sections of pipe to be tested, may be wetted before the air test. The line shall be plugged at each manhole with

pneumatic plugs. Low pressure air shall be introduced into the plugged line until the internal pressure reaches four (4.0) p.s.i.g. greater than the average back pressure of any ground water pressure that may submerge the pipe. At least two (2) minutes shall be allowed for the air temperature to stabilize before readings are taken and the time is started.

- The portion being tested shall pass if it does not lose air at a rate to cause the pressure to drop from 3.6 to 3.0 p.s.i.g. (greater than the average back pressure of any ground water that may submerge the pipe) in less than the time listed below. If failure of the test occurs in any section that section must be repaired and retested until satisfactory results are achieved.

Pipe Diameter in inches	Minimum Allowable Minutes 3.6 – 3.0 psig Pressure
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.5

- All service plugs shall be secured in place to prevent displacement during testing operations.

439.03 MANHOLE LEAKAGE TEST

- Manholes shall be tested by vacuum testing. Vacuum test after assembly and backfilling, but prior to paving. Care shall be taken to effect a seal between the vacuum base and the manhole rim. Pipe plugs shall be secured to prevent movement while the vacuum is drawn. A vacuum of 10 inches of mercury shall be drawn. The time for the vacuum to drop to 9 inches of mercury shall be recorded. If preformed plastic gaskets are pulled out during the vacuum test, the manhole shall be disassembled and the gaskets shall be replaced. Acceptance shall be defined as when the time to drop to 9 inches meets or exceeds the following:

Diameter	Time to Drop One Inch (1") Hg
4 ft.	60 seconds
5 ft.	75 seconds

- No manhole will be accepted if there is any visible infiltration when empty.
- All manholes installed will be tested. Any manhole whose test is unsatisfactory shall be repaired and retested until satisfactory results are obtained.
- Failure of any test is considered failure of the manhole involved.

439.04 VISUAL INSPECTION

- All new sewer lines shall be subject to inspection by lamping or other visual means. All new pvc pipe shall be subject to mandrel testing in accordance with section 1111.05.

2. All newly constructed sanitary sewer lines shall be completely jetted to remove dirt and debris prior to Construction Acceptance. The contractor will be responsible for removing all of the dirt and debris from the lines during the jetting operation and not allow any debris into any active City sewer line. Jetting shall be done after first lift of asphalt is completed. Please note that if City inspectors feel a problem exists with the line or if unusual problems occur during construction, the City, at its sole discretion, may require the lines to be videotaped by City personnel or by private contractor, at the developer's expense, prior to construction acceptance.
3. Contractor/Developer may, at his expense, hire an independent firm to videotape the sewer line. A designated City employee will be assigned to observe the camera work and video tapes of the line will be supplied to the City for further review.
4. Prior to the issuance of Final Acceptance, all of the sanitary sewer lines being considered shall be videotaped by City personnel. All defects found in the lines at the time of the camera operations shall be repaired prior to the City granting Final Acceptance. Please note that this work should be scheduled with the City by the Developer well in advance of final lift asphalt paving.
5. Manholes and sewer lines must be clean prior to scheduling video inspection. If rescheduling is necessary due to the fault of the Contractor, all costs for time lost on the originally scheduled camera inspection may be billed to the Contractor.

440.00 UTILITY MARKER SIGNS

1. Utility marker signs, provided by the City, shall be installed by the contractor next to manholes located in open fields or unpaved areas. Signs shall be spaced no more than four hundred feet (400') apart.

441.00 LIFT STATIONS - GENERAL

441.01 DESCRIPTION

This Section is a design guide for sewage lift stations and appurtenances. All sewage lift stations constructed in the City or areas serviced by the City shall conform with this Section.

441.02 TYPE OF LIFT STATIONS

Unless required otherwise, sewage lift stations shall be wet well stations with submersible pumps.

441.03 QUALITY ASSURANCE

Definition of terms and other hydraulic considerations are as set forth by the Hydraulic Institute Standards.

In the event of a conflict between the text portion of this document and the figures included in this document, the text portion shall govern. The electrical system shall be designed and stamped by an electrical engineer licensed in the state of Colorado. The hydraulic system shall be design and stamped by a civil engineer licensed in the state of Colorado. Unless noted otherwise, the materials used and methods of construction shall conform to the Standards and

Specifications. The City reserves the right to specify specific makes and models of equipment during the design or construction phase of any lift station. The final design documents shall be submitted to all applicable State and Local agencies for their review and approval.

441.04 FACILITY DESIGN REQUIREMENTS

The lift station design shall meet the criteria of the CDPHE design standards. The generator/valve vault building design shall meet all applicable UBC, ACI, Aluminum Associates (AA), IPC, UFC, National Electrical Code (NEC), and Uniform Mechanical Code (UMC) design codes and standards. Early in the design process, the City shall be contacted in order to coordinate the required flows and service area of the lift station. The City reserves the right to require that the lift station be designed as a regional facility.

442.00 LIFT STATIONS - PRODUCTS

442.01 LIFT STATION PUMPS

1. Performance and Design Requirements:
 - a. Pumping unit shall have a stable head capacity curve and be free of cavitation and objectionable noise throughout the full head and capacity range. Pumping unit shall be capable of handling raw, unscreened sewage, stormwater, and other similar solids-laden fluids without clogging.
 - b. Number of units:
 1. Lift stations shall consist of a minimum of two (2) pumps.
 2. The pumps shall be designed such that the station will remain fully operational and able to handle the design flows if one (1) pump fails or is removed from service.
 3. The pumps installed in each station shall be identical.
 4. One (1) spare pump shall be supplied with each station. Said pump shall be delivered to and stored at a location determined by the City.
 - c. Design pumps in accordance with the following:
 1. Pump Type: Submersible and Explosion Proof
 2. Number of Stages: Single
 3. Impeller Type: See paragraph 442.01.2.a.2
 4. Min. Suction Size (in): 4
 5. Min. Discharge Size (in): 4
 6. Min. Solid Size to Pass (in): 3

2. Construction

a. Materials:

1. Casing: ASTM A48, Class 40 Cast Iron
2. Impeller: ASTM A48, Class 40 Cast Iron; Double shrouded, single vane design or Semi-open, single vane design
3. Impeller Coating: PVC Epoxy Primer
4. Shaft: 420 Stainless Steel
5. External Hardware: 316 Stainless Steel
6. Oil Chamber: Cast Iron
7. Motor Housing: Cast Iron
8. Volute: ASTM A48, Class 40 Cast Iron

b. Components:

1. Casing - Discharge connections shall be standard class 125 cast iron flange. Mounting of pump to discharge pipe shall be an automatic connection when lowered into place. There shall be no need for personnel to enter wet well to connect or disconnect pumps. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a single linear downward motion of the pump. No portion of the pump shall bear directly on the floor of the wet well.
2. Mechanical Seal - Shaft sealing shall be accomplished by means of a tandem mechanical seal, the upper seals shall be either a tungsten carbide seal or a tool steel on carbon seal. The lower seal shall be either a tungsten carbide or a silicon carbide on tungsten carbide or silicon carbide Seal. Seals shall run in an oil reservoir.
3. Seal Gland - The bearing cover shall be machined to accept the seal cup to assure positive alignment of the seal faces.
4. Motor
 - a. The motor shall be submersible, induction shell type design, air filled, watertight chamber, and be in accordance with the latest NEMA standards. It shall have the following characteristics:
 1. Type: Enclosed Submersible and Explosion Proof
 2. Switches: Bimetallic

3. Number of Phases: Three
 4. Cycles: 60 Hz
 5. Voltage: 480 Volt
 6. Insulation: Type F with Class B rise
- b. Each motor shall have a sufficient horse power rating to operate the pump at any point on the pump's head capacity curve without overloading the nameplate horsepower rating of the motor regardless of service factor. The motor shall have a service factor of 1.15. The service factor is reserved for variations in voltage and frequency.
 - c. The motor shall be designed for continuous duty and be capable of sustaining 15 evenly spaced starts per hour.
 - d. Each phase of the motor shall contain a bimetallic temperature monitor in the upper portion of the stator windings. Monitors shall be connected in series. Temperature setting shall be 140° C ± 5° C. Monitors to automatically reset when stator temperature returns to normal.
 - e. Provide either electrical float in motor chamber or electrical probe in seal oil chamber for detecting the presence of water. A solid state device in the control panel shall send a low voltage, low amperage signal to probe. The presence of water in the motor chamber or oil chamber shall send a signal to the telemetry system.
5. Bearings - Pump shaft shall rotate on two (2) permanently lubricated bearings. The upper bearing shall be a single row ball bearing and the lower bearing a two row angular contact ball bearing.
 6. Wear ring - shall be installed to provide efficient sealing between the volute and the impeller. The wear ring shall consist of a stationary ring which is to be drive fitted to the volute inlet.
 7. Self Cleaning Front Plate - In lieu of a wear ring, a self cleaning front plate (wear plate) may be used. If so, it shall be ASTM A48, Class 40 ductile iron, adjustable with wave shaped inlet and outward spiraling V-shaped groove facing the impeller.
- c. Accessories:
 1. Rail Mounting System
 - a. Rail mounted system shall be type 316 stainless steel. The connecting hardware and anchor bolts shall be type 316 stainless

steel. System shall be designed for removing pumps without entering wet well.

- b. Guide rails and bracket sizes shall be in accordance with the manufacturers recommendations.
- c. Support and installation shall be in accordance with manufactures guidelines and recommendations.
- d. The discharge connection elbow and piping shall be permanently installed in the wet well.

2. Lifting Chain

- a. A lifting chain shall be provided to raise and lower the pump. The chain shall be type 316 stainless steel. The chain shall have sufficient strength to support the pump, break the seal between the pump and the discharge piping, and support any fluid which may remain in the pump as it is being lifted.

3. Manufacturers: See APPROVED MATERIALS LIST.

442.02 WET WELL

1. Layout

- a. The wet well shall consist of one (1) chamber. Exceptions to this rule shall be at the discretion of the City.
- b. If more than one chamber is allowed, they shall be configured in a manner such that detention times are minimized. Also, fillets shall be provided in all the chambers in order to reduce deposition of solids.
- c. There shall be a manhole installed on the interceptor sewer immediately upstream of the wet well. Said manhole shall be ten to fifteen (10-15) foot clear distance from the wet well. This manhole shall be used for emergency bypass pumping.
- d. There shall be an emergency bypass line installed next to the wet well.
 1. The bypass line shall be constructed of coated DIP. The line shall be sized to carry the design flow if it is pumped continuously by a single emergency pump.
 2. The bypass line shall terminate in a valve box.
 3. The bypass line shall have a flanged end capped with a blind flange.

2. Materials - Concrete

a. The wet well shall be constructed of either cast-in-place or precast concrete. The concrete shall meet the following requirements regardless of whether the concrete is cast-in-place or precast.

1. $f'c = 4000$ psi @ 28 days
2. slump = 3" \pm 1"
3. entrained air = 6% \pm 1%
4. cement: Type VA
5. maximum water to cement ratio = 0.45
6. reinforcement: ASTM A615, Grade 60
7. calcium chloride is not allowed as an admixture
8. fly ash is not allowed as an admixture
9. calcareous aggregate shall be used

b. Interior Coating System

1. The interior of the wet well shall be coated with one of the following products.
 - a. See APPROVED MATERIALS LIST.
2. Epoxy and bituminous systems are not allowed.

c. Exterior Coating - The exterior should be coated using approved waterproofing material.

3. Appurtenances

a. Wall penetrations

1. Wall penetrations in the wet well shall be accomplished by coring the concrete or by the use of temporary block-outs during the casting process.
2. All pipe sections which are to pass through the wall penetrations shall be DIP.
3. The gap between the DIP passing through the penetration and the concrete shall be sealed with two (2) Segmental Sealing units with type 316 stainless steel hardware. Cover the Sealing units with non-shrink grout. Grout shall be installed such that it is smooth with the face of the wall.

4. There shall be a flexible joint outside the wet well within twelve to eighteen (12-18) inches of the exterior face of the wall.
- b. Hatches
1. There shall be one (1) hatch per chamber in the top slab to allow for pump removal and personnel access. Additional hatches may be allowed at the discretion of the City.
 2. The hatch shall be lockable and no smaller than the minimum size required by the pump manufacture in order to adequately service and remove the pumps with a minimum clear opening of forty eight (48) inches in any direction.
 3. See APPROVED MATERIALS LIST for allowed models.
 4. The hatch shall be equipped with a recessed hasp covered by a hinged lid flush with the surface of the hatch.
 5. Pipe the frame drain such that it flows into the wet well.
- c. There are to be no access steps or ladders permanently installed within the wet well.
- d. Discharge piping in the wet well shall be made up of flanged sections. Pipe shall be DIP. DIP pipe shall have an exterior bituminous coating and a double cement mortar lining.
- e. Work platforms - None required.
- f. All interior electrical systems inside the wet well shall be explosion proof.
- g. No air vents are to be installed in the wet well.
- h. Lights - None required.
- i. A trash rack and/or bar screen are not permitted.

442.03 MOTOR CONTROL CENTER

- a. The contractor will provide two (2) inch conduit from control house to wet well for level sensor and high water alarms.
- b. The contractor will provide two (2) inch conduit from motor control center in control house to city installed Remote Terminal Unit (RTU) cabinet.
- c. The contractor will provide conduit and 120 VAC power to RTU cabinet.
- d. The contractor will install HOA switches for each pump on front of Motor starter bucket.

- e. The contractor will wire hand contacts and the city will wire to auto contacts.
 - f. The city will install RTU cabinet, level sensor, float switches, radio antenna and cable.
1. Panel enclosure shall be NEMA 4. Inner door shall be provided. It shall be fabricated from 5052-H32 .080 marine alloy brushed aluminum. It shall be completely removable and held closed by at least two, 1/4 turn fasteners. It shall be capable of being locked shut by either an integral lock or pad lock. Supply the lock and two (2) keys. Locks shall be keyed per City's requirements. Provide heating system which will maintain temperature 2° to 3° F above ambient temperature in order to prevent condensation within the enclosure.
 2. Provide fused 120 VAC control power circuit derived from incoming 480 VAC power. Transformer shall be sized to handle all load within the control panel. Provide transformer output with 15 AMP circuit breaker.
 3. All labeling both within the enclosure and external shall be laser screened laminated Mylar.
 4. Motor and control circuit breakers shall be molded case. Minimum interrupting rating 18,000 AMPS RMS SYM at 480 volts. Acceptable manufacturers are:
 - a. See APPROVED MATERIALS LIST.
 5. Motor starters shall be full-voltage, non-reversing NEMA HP rated and equipped with a minimum of one n.o. auxiliary contact for customer's use. Acceptable manufacturers are:
 - a. See APPROVED MATERIALS LIST.
 6. Provide ambient compensated overload relays of the bimetallic type. Overload relays to have electrically isolated n.o./n.c. contact to annunciate motor overload condition.
 7. Relays shall be plug-in design with transparent polycarbonate dust cover. All relays to have 3PDT contacts and molded nylon coil rated for continuous duty. Coil voltage to be 24 VAC or 120 VAC. Relay contacts shall be rated for 10 amps at 300 VAC.
 8. Provide phase monitor relay to monitor loss of phase, phase reversal and under voltage. Unit shall stop pump motors after detection of fault. Unit shall automatically reset after fault is cleared.
 9. Provide a running time meter for each pump. Non-resettable, reading in hours and tenths up to 99999.9
 10. Provide a lightning arrestor/surge capacitor at the panel service entrance. Solid state type. Capable of clamping in 5 nanoseconds and absorb 25KA peak surge current. Life expectancy of 10,000 occurrences at 200 amps.

11. Provide a duplex GFCI convenience receptacle on a dedicated 20 AMP 120 VAC branch circuit within the panel.
12. The panel manufacturer shall be U/L certified as a U/L 508 manufacturing facility and certified to install a serialized label for quality control and insurance liability considerations. Panel shall meet the following standards as a minimum:
 - a. Institute of Electrical & Electronic Engineers
 - b. National Electric Code
 - c. National Electrical Manufacturers Association
 - d. American National Standards Institute
 - e. Underwriters Laboratories 508
13. In the event that a motor over-temperature switch is activated, the pump shall shut down until the switch is automatically reset.

442.04 GENERATOR/VALVE VAULT BUILDING

The emergency generator and valve vault shall be housed in a single building. The building shall be designed by an Architect licensed in the state of Colorado. The design of the building will be one such that it will blend into its surroundings. During the design process, the Architect shall provide a rendering of the proposed building to the City for review. The City reserves the right to reject or request modifications to any architectural design. The building shall be submitted to all of the City's applicable planning review processes. The architecture of the building shall blend with adjacent buildings.

1. Layout
 - a. The building shall be sized to provide sufficient room for the emergency generator, control panels, jib crane, sink, water heater, unit heater, and valve vault.
 - b. Minimum clearances shall be provided around the following equipment (clearances may overlap):

1. Emergency generator:	4' (2' is allowed along intake side of generator)
2. Control panels and electric equipment:	per code
3. Between generator and valve vault:	6'
4. Width of main entry way:	6'
5. Between piping and wall and/or stairs:	3'
6. Between face of flange and face of wall:	18"

- c. Pitch of roof shall be 4:12 minimum and 8:12 maximum, unless otherwise approved by City.
- d. Install gutters and downspouts in order to control drainage coming off of roof.

2. Materials

- a. Acceptable interior finish - concrete masonry units
- b. Acceptable exterior finishes - Facade
 - 1. Fluted or split face block
 - 2. Brick
- c. Trim
 - 1. Aluminum
 - 2. Masonry
 - 3. Painted Plastic
- d. Roof
 - 1. Asphalt shingles
 - 2. Concrete tiles
 - 3. Clay tiles
 - 4. Composite shingles
 - 5. Or other material as approved by the City.
- e. Gutters and downspouts
 - 1. Aluminum
 - 2. Painted plastic
- f. Lights - Provide photocell switch with lights on the exterior of the building in order to illuminate the entranceway.

3. Appurtenances

- a. Plumbing
 - 1. The building shall be supplied with potable water.

2. All applicable IPC requirements are to be followed.
 3. Provide a stainless steel utility sink with hot and cold water taps. The drain from the sink shall be plumbed to drain into the wet well. Provide a p-trap on the sink drain line. Provide a rubber stopper for the sink drain.
 4. Provide a hose bib, 50' hose, and hose rack inside the building.
 5. Provide backflow preventers and meters on all service lines to building.
 6. Provide a single toilet water closet.
- b. Vents
1. Provide motor controlled intake and exhaust louver vents in the walls of the building as required in order to meet all applicable code imposed air exchange requirements and in order to provide necessary air flow to and from the emergency generator.
 2. The louvers shall automatically open when the emergency generator starts.
- c. Doors
1. Provide a set of metal double doors.
 2. Each door shall be 3'-0" wide by 6'-8" tall or wide enough to get generator in and out.
 3. Provide thief proof hinges
 4. Doors shall contain dead bolt passage set. Locks shall be keyed per City's requirements.
 5. Provide a bumper and hook for each door to secure door in open position.
- d. Lighting
1. Provide adequate overhead lighting to illuminate the entire building, including corners and the recessed valve vault.
 2. The light switch(s) for the overhead lighting shall be located next to the double doors.
 3. The lighting panel shall be 120 volt, 3 phase.
- e. Electrical Outlets
1. Provide a duplex GFCI outlet on each interior wall of the building.
- f. Jib Crane

1. Install a jib crane in the building in a location which does not interfere with the operation of any of the equipment in the building, however still allowing the jib crane to reach any portion of the piping in the valve vault and any portion of the emergency generator.
 2. Jib crane shall have a minimum capacity of 1000 pounds when fully extended.
 3. Jib crane shall have sufficient capacity and length of chain to pick a 1000 pound object off the floor of the valve vault.
 4. Manufacturer – See APPROVED MATERIALS LIST.
- g. Water Heater
1. Install a five (5) gallon, natural gas or electric water heater in the building.
 2. Vent the water heater per code requirements.
- h. Unit Heater
1. Install a natural gas unit heater in the building.
 2. The unit heater shall be sized such that it can warm the entire interior of the building to 80° F during the winter months. The unit heater shall be controlled by a thermostat.

442.05 VALVE VAULT

1. Material - The valve vault shall be constructed of either cast-in-place or precast concrete. The concrete shall meet the following requirements regardless of whether the concrete is cast-in-place or precast.
 - a. $f'c = 4000 \text{ psi @ 28 days}$
 - b. slump = 3" \pm 1"
 - c. entrained air = 6% \pm 1%
 - d. cement: Type IIA
 - e. maximum water to cement ratio = 0.45
 - f. reinforcement: ASTM A615, Grade 60
 - g. calcium chloride is not allowed as an admixture
 - h. fly ash is not allowed

2. Exterior Coating System - The exterior of the valve vault shall be coated with a coal tar damp-proofing agent. Damp-proof agent shall be applied in one coat and be 14 mils minimum dry film thickness.
 - a. Manufacturers
 1. See APPROVED MATERIALS LIST.
3. Layout
 - a. The valve vault shall be housed inside a single building with the emergency generator.
 - b. The valve vault shall be made up of a below grade, open basement. The basement shall be designed to support construction loads caused by backfilling operations and the loads produced by vehicles driving around the basement after construction is completed.
 - c. Access to the valve vault shall be accomplished by a stairway.
 1. Stairs shall be either concrete, aluminum, or stainless steel.
 2. Maximum rise of stairs shall be seven (7) inches.
 3. Minimum run of stairs shall be eleven (11) inches.
 4. Minimum width of stairs shall be forty eight (48) inches.
 5. Provide a handrail along stairs.
 6. Provide a 4'-0" x 4'-0" minimum landing (clear area) at the bottom of the stairs.
 - d. General - Provide a removable, aluminum handrail around the perimeter of the valve vault.
 1. Conform to applicable AA & UBC standards.
 2. Protect aluminum in contact with other metals, grout, and concrete by a heavy brush coat of alkali-resistant bituminous coating, or a nonporous tape or gasket. Coating is not required for aluminum in contact with stainless steel bolts. Apply bituminous coating at 15-mil minimum dry-film thickness.
 3. Bituminous coating shall be one of the following:
 - a. See APPROVED MATERIALS LIST.
 4. After installation and cleaning, protect aluminum with a clear methacrylate lacquer coating.

- e. Rails and Posts.
 - 1. Conform to ASTM B221.
 - 2. 1-1/2 inch nominal diameter (1.9 inch o.d.), Schedule 40, aluminum Alloy 6063-T6 with clear anodized finish AA-M32C22A41 (exterior use).
 - 3. Cope intersections of rails and posts, weld joints, and grind smooth to a pleasing appearance, taking care not to excessively remove weld material.
 - 4. Butt-weld end-to-end joints, or use welding connectors.
 - 5. Provide linear expansion joints a maximum of 40'-0" on center.
 - 6. Space posts at a maximum of 5'-0" on center.
 - 7. Firmly attach each rail to adjacent walls.
 - f. Fittings and Accessories - Fasteners and anchors of stainless steel and of type as required by substrate.
 - g. Toeboard (Kick Plate).
 - 1. Extruded, beveled aluminum 4 inch height, aluminum Alloy 6063-T6, with splice plates and corner connectors or equal. (See APPROVED MATERIALS LIST)
 - 2. Furnish required stainless steel clamps and fasteners for complete installation.
 - 3. Install toeboards (kick plates) and anchor to each post with clamps and bolts. Allow 1/4 inch space between bottom of toeboard and top of floor surface.
 - h. Mechanical handrail system using stainless steel set screws (See Approved Materials List) may be used in lieu of an all welded handrail system.
 - i. Provide a floor drain in valve vault.
 - 1. Pipe the drain line into the wet well.
 - 2. Provide a p-trap and ball-float check valve at floor drain. (See APPROVED MATERIALS LIST)
4. Appurtenances
- a. Piping shall be flanged ductile iron and shall be double cement mortar lined.
 - 1. Exterior coating shall be alkyd enamel, gloss.

- a. Alkyd Enamel, Gloss System; F.S. TT-E-489, Cl. A. Surface Prep: SSPC-SP6, Commercial Blast.
 - b. Use a primer and/or tie-coat as recommend by coating manufacturer.
 - c. There shall be a minimum of at least three coats of paint including primer at the conclusion of field painting. At least two of the coats must be field applied.
 - d. Dry film thickness shall be 5 to 7 mils.
- 2. Install piping a minimum of 2'-0" above finished floor elevation.
- b. Swing Check Valves
 - 1. Install a swing check valve on each line from the wet well and on the emergency bypass line.
 - 2. Swing check valves must comply with the requirements of AWWA C508.
 - 3. Construction
 - a. Single disk, horizontal swing type valves, quick closing with unobstructed waterway.
 - b. Tight closing with external spring and lever.
 - c. Body: Cast iron (semi-steel), ASTM A126, Grade B; or cast steel, ASTM A216.
 - d. Shaft: Stainless steel with bronze bushed bearings and outside stuffing boxes.
 - e. Valve Ends: Flanged.
 - f. Seats, seat rings, pins, and bushings: Bronze.
 - g. Disc: Cast iron (semi-steel), ASTM A126; cast steel, ASTM A216; or type 304 stainless steel.
 - h. Disc Facing: Bronze.
 - 4. Manufactures
 - a. See APPROVED MATERIALS LIST.
- c. Eccentric Plug Valves - Install an eccentric plug valve on each line from the wet well, the end of the discharge manifold, and the emergency bypass line.
 - 1. Manufacturer – See APPROVED MATERIALS LIST..

- d. Flow Meter - to be supplied by the City
 - 1. Install a magnetic flow meter on the discharge manifold.
 - 2. Meter is to be placed such that all flow entering the force main will be measured whether the flow is originating from the pumps in the wet well or if the flow is originating from the emergency bypass line.
 - 3. Installation of the meter shall meet all of the meter manufacturer's requirements for minimum length of upstream and downstream straight pipe around the meter, in order to isolate the meter from turbulence. At a minimum, the meter shall be installed with 5 diameter lengths of pipe upstream and 2 diameter lengths of pipe downstream.

- e. Wall penetrations
 - 1. Wall penetrations in the valve vault shall be accomplished by coring the concrete or by the use of temporary block-outs during the casting process.
 - 2. All pipe sections which are to pass through the wall penetrations shall be DIP.
 - 3. The gap between the DIP passing through the penetration and the concrete shall be sealed with two (2) Segmental Sealing units with type 316 stainless steel hardware. Cover the Sealing units with non-shrink grout. Grout shall be installed such that it is smooth with the face of the wall.
 - 4. There shall be a flexible joint outside the valve vault within 12" to 18" of the exterior face of the wall.
 - 5. All pipe passing through wall penetrations shall be restrained by means of stainless steel restraining rods and hardware.

- f. Blower
 - 1. Install a blower (discharge fan) in the valve vault.
 - 2. The on/off switch for the blower shall be located next to the on/off switch for the overhead lights.
 - 3. The intake for the blower shall be twelve inches above the floor of the valve vault to assure removal of any gases which are heavier than oxygen.
 - 4. Size the blower such that it will be able to provide the recommended number of air changes for the valve vault as called out in "Design Criteria Considered in the Review of Wastewater Treatment Facilities" as published by the Colorado Department of Public Health and Environment.

5. The blower shall discharge through the wall of the valve vault.
- g. Install a GFCI protected electric outlet in the valve vault.

442.06 GENERATOR

Generator shall be powered by means of natural gas or diesel unless otherwise approved. Generator controls are to be per manufacturer's requirements and recommendations. Provide a cooling system for the generator. The cooling system shall be designed to prevent the generator from raising the ambient air temperature inside the building above 105° F. Generator shall be capable of delivering 125% the amount of power required to operate all electrical equipment and outlets in both the generator/valve vault building and the wet well. The equipment to be powered shall include, but is not limited to the pumps, telemetry and control systems, lights, louvers, air vent, electric outlets, and jib crane. Generator shall startup after a power loss lasting a specified period of time. The time delay before generator startup shall be controlled by equipment supplied by the generator manufacturer. Equipment shall be capable of a time delay of 0 seconds to 15 minutes. Said equipment shall be capable of being reset and shall be field adjustable. Generator shall shutdown after the power has returned for a specified period of time. The time delay before the generator shuts down shall be controlled by equipment supplied by the generator manufacturer. Equipment shall be capable of a time delay of 0 seconds to 15 minutes. Said equipment shall be capable of being reset and shall be field adjustable. Contractor shall provide a minimum one day fuel reserve tank.

1. Manufacturers
 - a. See APPROVED MATERIALS LIST.

442.07 SITE SECURITY

The site shall have a security system which will monitor unauthorized access to the generator/valve vault building and to the wet well. The security system shall consist of a limit switch on the access hatch(s) to the wet well and a limit switch on the doors to the building. When a door or hatch is opened, an alarm signal shall be sent to the telemetry system. The security system shall include a lock and key operated, manual override system. The manual override lock shall be mounted inside the building on the wall next to the control panel. Locks for the manual override shall be keyed per City's requirements. The security system shall include a time delay to allow maintenance personnel time to operate the manual override before an alarm signal is sent to the telemetry system. The delay shall be field adjustable with a minimum time range of 0 seconds to 5 minutes.

442.08 SITE

Landscaping shall meet current City Standards and Specifications. All facilities (i.e., the valve vault building, wet well, and first upstream manhole) shall be located on one lot. The lot shall be of sufficient size to accommodate all facilities and minimum required clearances around facilities. The lot shall be deeded over to the City after all construction has been completed and approved by the City. There shall be a minimum of 20'-0" clear between all facilities or equipment and the nearest lot line.

- a. Concrete Drive - The drive to the valve vault building shall be constructed of polypropylene fiber reinforced concrete. Drive shall be a minimum of 6" thick.

Expansion and contraction joints shall be provided as needed. Drive shall be design to support AASHTO HS-20 loads. If required, proved welded wire fabric in drive to provide required strength. Drive shall be a minimum of 20'-0" wide.

- b. Grass-Crete - In order to provide a stable driving surface around the site, the site shall be landscaped with grass-crete (grass grown in a masonry unit base). The grass-crete shall be in all locations not otherwise occupied by structures or the access drive. The type of grass to be used in the grass-crete shall be per the City's requirements.

442.09 INTERCEPTOR

1. The interceptor consists of the section of pipe entering the manhole immediately upstream of the wet well and section of pipe from said manhole to the wet well.
2. The interceptor shall be C900 PVC in locations where trench conditions can be maintained. Trench conditions will not be considered maintained if there is more than 6" of excavation beneath the interceptor. The City reserves the right to stipulate the use DIP at any location along the interceptor.
 - a. Provide appropriate coupling when switching from C900 PVC to DIP. Match inverts to maximum extent possible when switching between the two pipe materials.
3. The section of the interceptor from the manhole immediately upstream of the wet well to the wet well shall be a plane end by flanged end section. The flanged end of the pipe shall be installed in the wet well. The flange shall be a minimum of six (6) inches clear from the wet well wall. Restrain the flanged end of the pipe by means of stainless steel restraining rods and hardware.

442.10 FORCE MAIN

The force main begins at the flexible joint leaving the valve vault. At the City's discretion, more than one force main may be required at any lift station. The flow velocity of the sewage in the force main shall meet the following criteria, unless approved otherwise by the City:

- a. Minimum Velocity: 3.5 feet per second.
 - b. Maximum Velocity: 5 feet per second.
1. Pipe Materials
 - a. C900 PVC unless otherwise approved.
 2. Termination of force main
 - a. The force main is to continue until it discharges into a gravity sewer.
 - b. The force main connection to the gravity sewer manhole is to be per City Standards and Specifications.

- c. Termination manhole is to be a standard precast manhole, if it does not already exist.
 - d. The force main is to connect into the manhole at the same elevation as the gravity sewer and along an alignment which will minimize the turbulence created in the sewage as it discharges from the force main.
 - e. The force main is to enter the manhole at a positive grade in order to avoid creating a siphon in the line.
3. High points are to be avoided in the force main. However, if they cannot be avoided, sewage air release valves with ball valves are to be installed at all high points.
4. Testing - Force main shall be pressure tested in accordance with section 529.00 of these Standards and Specifications.
5. Tracing Wire
- a. The force main shall be installed with tracing wire taped securely to the top of the pipe and shall extend along the entire length of the pipe installed. The tracing wire shall be a minimum 14 AWG direct bury solid copper wire. See Trench Detail 100-01. The tracing wire shall be tested prior to and as a condition of construction acceptance.
 - b. Tracing wire shall be brought to grade at all eccentric plug valves or at test stations as shown on the approved plans. The tracing wire shall be securely affixed to the body of the valves and coiled around the body with an excess length of approximately 16" (sixteen inches).
 - c. For pipe located outside a roadway, the same as above shall be done and there shall also be a warning tape installed 18" (eighteen inches) directly above the pipe.
6. Eccentric plug valves shall be placed in force main with maximum spacing of 1000 feet.
- a. Valves are to be specifically designed to be used on a wastewater pipeline.
 - b. Ball valve is to be installed between the force main and the air relief valve.
 - c. Ball valve is to be rigidly attached to the force main to allow the removal of the air relief valve.
 - d. Air Relief Valve Manufacturer – See APPROVED MATERIALS LIST.
 - e. Valves are to be placed in City standard manholes or valve boxes.

443.00 LIFT STATIONS - EXECUTION

443.01 INSTALLATION

1. Mount each pump and drive assembly on a single heavy baseplate.

2. Level, plumb, align and wedge each pumping unit into position to fit the connecting piping.
3. Install as recommended by pump manufacturer, Hydraulic Institute Standards, and as required in this document.
4. Grout each pump base after initial fitting alignment but before final bolting of connecting piping.
5. Take special care to maintain alignment of pumping unit components.
6. Transmit no stress to pump flanges.
7. Test pump connections for applied piping stresses, after final alignment and bolting, by loosening flange bolts.
8. Adjust piping to proper fit if movement or opening of joints is observed.
9. Realign couplings between motors and pumping units after grouting.
10. Shimming between machined surfaces will not be permitted.
11. All equipment shall be furnished by a single supplier who shall be responsible for equipment compatibility.

443.02 MANUFACTURER'S FIELD SERVICES

Pumps:

1. Manufacturer's field representatives shall visit the site during construction at appropriate times to assist contractor in installing and operating the equipment. The manufacturer's services shall include, but not be limited to, the following:
 - a. Perform a check of the completed installation; supervise initial startup, adjustments, and testing.
 - b. Instruct City's personnel in proper operation and maintenance.
 1. After equipment is operating satisfactorily.
 2. Schedule instruction period independently of other field services.
 - c. Measure three-phase line currents and phase voltages to demonstrate balanced electrical operating conditions.
 1. Motor readings shall be taken at the motor.

Contractor shall furnish skilled workmen and attendants as required to complete activities that must be performed. Manufacturer's field representatives shall furnish to City, with copies to contractor, a written Equipment Checkout Report.

- a. Certify that the equipment:
 1. Has been properly installed and lubricated.
 2. Is in accurate alignment.
 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
 4. Has been operated satisfactorily under full load conditions.
- b. Include table of measured line currents and corresponding phase-to-phase voltages.
 1. State motor nameplate amps
- c. If requested, furnish VHS format instructional video tape.

Emergency Generator

1. Manufacturer's field representatives shall visit the site during construction at appropriate times to assist contractor in installing and operating the equipment. The manufacturer's services shall include, but not be limited to, the following:
 - a. Perform a check of the completed installation; supervise initial startup, adjustments, and testing.
 - b. Instruct City's personnel in proper operation and maintenance.
 1. After equipment is operating satisfactorily.
 2. Schedule instruction period independently of other field services.
2. Contractor shall furnish skilled workmen and attendants as required to complete activities that must be performed.
3. Manufacturer's field representatives shall furnish to City, with copies to Contractor, a written Equipment Checkout Report.
 - a. Certify that the equipment:
 1. Has been properly installed.
 2. Has been operated satisfactorily.

443.03 SPARE PARTS

Provide one complete set of spare parts as recommended by the manufacturers of the pumps, control and telemetry system, generator, and jib crane. The spare parts shall include, but not necessarily be limited to, the following:

- a. One mechanical seal per pump.
- b. One wear ring or wear plate per pump.
- c. One complete set of gaskets and O rings per pump.
- d. One complete set of fuses.
- e. Motor