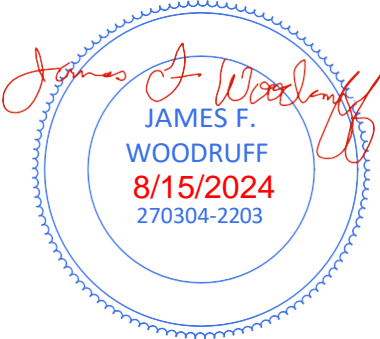


KEARNS IMPROVEMENT DISTRICT
DESIGN STANDARDS
&
CONSTRUCTION SPECIFICATIONS



Kearns Improvement District



Adopted by the Kearns Improvement District Board of Trustees
October 2024

DESIGN STANDARDS & CONSTRUCTION SPECIFICATIONS

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STANDARD DRAWINGS-SEWER

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Section 1 – GENERAL

1.1 Definitions and References

- A. AS-BUILT DRAWINGS: Drawings which depict the improvements as installed, including field changes, revisions, etc. Sometimes called “Record Drawings”.
- B. BONDS / LETTER OF GUARANTEE: Instruments of security, furnished by the Developer and his surety in accordance with KID Policy to assure the installation of improvements or to guarantee their performance.
- C. CONTRACTOR: The person, firm or corporation retained by the developer who is responsible for all construction work in the development.
- D. DISTRICT: The Kearns Improvement District (KID)
- E. DISTRICT ENGINEER: The Licensed Engineer, employed or retained by KID, including such agents and assistants as are authorized to represent him, who represents KID.
- F. DRAWINGS: The part of the approved plans which show the characteristics and scope of the WORK to be performed, and which have been approved by the District Engineer.
- G. ENGINEER: The Company or firm and its employees retained by the developer providing the engineering services for the development; also referred to as project engineer or engineer of record.
- H. INSPECTOR: The authorized agent of KID or District Engineer assigned to make detailed inspections of any or all portions of the water and sewer system construction.
- I. LATERAL: The sewer line and appurtenances extending from 2 feet outside of the building to the public sewer, including the connection to the sewer main.
- J. OWNER or DEVELOPER: The person, firm or corporation who initiates the project and authorizes expenditures for its construction.
- K. PROJECT: The undertaking to be performed as provided in the Drawings and Specifications.
- L. SECONDARY WATER SYSTEM: A water system, separate from the culinary or potable system, which is intended to provide irrigation water. The water used in such a system may be reuse water, canal water, well water, or combinations of such.
- M. “SHALL”/”SHOULD”: Where the term “shall” be used, it is intended to specify a mandatory requirement. Other terms such as “should”, “may”, and “recommend” indicate discretionary use.
- N. SPECIFICATIONS: A written description of the technical nature of materials, equipment, construction systems, standards and workmanship.
- O. SUBCONTRACTOR: An individual, firm or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work.
- P. SUBSTANTIAL COMPLETION: That date when the construction of the Project or a specified part thereof is sufficiently complete, in accordance with the Drawings and Specifications, so that the Project or specified part can be utilized for the purposes for which it is intended such acceptance shall be the date when the Board of Trustees of KID accepts the improvements which comprise the Project or designated part of the Project.
- Q. SUPPLIER: Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the work site.
- R. WORK: All labor necessary to produce the construction required by the Drawings and Specifications, and all materials and equipment incorporated or to be incorporated in the Project.
- S. AWWA References (use latest edition)
 - 1. AWWA C104/A21.4, ANSI Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 - 2. AWWA C110/A21.10, ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3” through 48”, for Water.
 - 3. AWWA C111/A21.11, ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C151/A 21.51 ANSI Standard for Ductile Iron Piping, Centrifugally Cast, for Water or Other Liquids.
5. AWWA C500, Metal Seated Gate Valves for Water Supply Service.
6. AWWA C502, Dry-Barrel Fire Hydrants.
7. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
8. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
9. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings 4 In. Through 12 In. for Water Distribution.
10. AWWA C904-06, Cross-Linked Polyethylene (PEX) Pressure Pipe 1/2 In. Through 3 In. for Water Service
11. AWWA C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. Through 12 In. for Water Distribution.

T. ASTM References (use latest edition)

1. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings.
6. ASTM B88 Standard Specification for Seamless Copper Water Tube.
7. ASTM B124 Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
8. ASTM C33 Standard Specification for Concrete Aggregates.
9. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
10. ASTM C150 Standard Specification for Portland Cement.
11. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
13. ASTM C478 Standard Specification for Pre-cast Reinforced Manhole Sections.
14. ASTM D3034 Standard Specification for Type PSM Poly (vinyl chloride) (PVC) Sewer Pipe and Fittings.
15. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
16. ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.

U. Miscellaneous References

1. Federal Specification SS-S-210(A) Sealing Compound, Preformed Plastic, for Expansion Joints & Pipe Joints.
2. MSS SP-11 Gray-Iron and Ductile-Iron Tapping Sleeves.
3. AASHTO T-180 (Method D-Modified), Moisture-Density Relation of Soil using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop.
4. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
5. ACI 305R Hot Weather Concreting
6. ACI 306R Cold Weather Concreting
7. ACI 347 Guide to Formwork for Concrete

V. Abbreviations

1. AWWA: American Water Works Association
2. ASTM: American Society for Testing and Materials
3. MSS: Manufacturer's Standardization Society
4. AASHTO: American Association of State Highway and Transportation Officials
5. ACI: American Concrete Institute
6. ANSI: American National Standards Institute

1.1 New Project Development Procedures

1.2 Development Checklist

Name of Project:			
Location:			
Item No.	Item Description	Completed	Date
1.	Request for Letter of Availability for service		
2.	Submittal of Preliminary Design Drawings – Electronic PDF Submittal		
3.	Prepare Water Restriction Calculations of requested water for the development of all projects. See section 1.3A.		
4.	Preliminary Design review – Returned to Developer’s engineer for red-line corrections (Electronic)		
5.	Re-submittal of corrected Design Drawings (Electronic PDF Submittal)		
6.	Upon review & KID acceptance – (Electronic PDF Set Plan Approved)		
7.	Submittal of subdivision mylar for KID District Engineer signature		
8.	Bond/Letter of Guarantee amount calculated. Provide to Developer & Engineer		
9.	Review fees, connection fees, and impact fees determined. Provide to developer & engineer		
10.	Bond/Letter of Guarantee accepted, payment of review fees, connection fees, and impact fees received by KID		
11.	Project Pre-construction meeting is set, participants notified (Developer, District Engineer, KID Inspector, Project Engineer)		
12.	Hold Pre-construction meeting at KID Office.		
13.	Construction Inspection (See inspection checklist a. Electronic approved plans used by Inspector. b. Electronic Inspection reports		
14.	Contractor provides video, pressure, and test results of sewer lines.		
15.	Contractor provides water pressure tests.		
16.	KID tests and receives certified laboratory test results of successful bac-t testing of water lines.		
17.	KID Inspector creates electronic punch list for Contractor		
18.	A set of “As-built” construction drawings in electronic PDF format is provided to the District Engineer for review.		
19.	Contractor requests review of corrected punch list items. Inspector review and sign off when all items are corrected.		
20.	District Survey’s (GPS) all water and sewer infrastructure.		
21.	The District Engineer compares the “As-built” submittal to District Survey of plans. Lists of discrepancies, or problems, are provided to the Project Engineer.		
22.	Final corrected “As-built” drawings in electronic ACAD format and PDF copy is provided to the District Engineer for project acceptance.		
23.	With written approvals from the KID Inspector and KID Engineering, the KID District Engineer prepares a request for bond/Letter of Guarantee reduction for the KID Board of Trustees consideration on the next KID Board of Trustees meeting agenda. A copy of the request is provided to the Contractor.		
24.	“As-built” drawings are added to the KID –GIS mapping system		

25.	Upon completion of the 1-year warranty period, the KID Inspector conducts a final inspection of the utility installation to identify any deficiencies which may have occurred as a result of poor materials or workmanship.		
26.	Upon finalization and approval by the KID Inspector, the District Engineer prepares a request for Bond/Letter of Guarantee release for the KID Board of Trustees consideration on the next KID Board of Trustees meeting agenda. A copy of the request is provided to the Contractor.		
27.	Project complete. KID accepts responsibility of project sewer and water infrastructure.		

1.3

Developer's Project Engineer's Responsibility

- A. If a development is over 35 acres, Jordan Valley Water Conservancy District restricts the availability of water to 1.35 ac-ft per acre per year. If the development does not meet this requirement, the developer will need to bring additional water shares to JWCD or purchase additional water shares from JWCD. The Water Restriction Calculator will need to be filled out by the developers' project engineer.
- B. Developer's Project Engineer shall design the water and sewer system in accordance with these Design Standards and Construction Specifications, and per current AWWA Standards, good engineering practices and the normal standard of care.
- C. The Developer's Project Engineer shall upsize the water and sewer system as required by the District Engineer. The developer may be eligible for reimbursement for upsizing.
- D. Where required by the District Engineer, detailed computations, including hydraulic calculations showing, flow, pressure, velocity, head loss, depth of flow, water surface profiles, and gradients shall be submitted with the project plan submittal.
- E. KID shall not be responsible for any errors in the design, construction changes required due to an oversight of the Developer and/or the Developer's Project Engineer, or upgrades required because of a lack of planning, incompetence or negligence by the Developer and/or the Developer's Project Engineer.

1.4 Drawings

- A. Drawings shall be prepared on D sized drawings, shall be drawn to scale, and shall provide sufficient detail to allow construction of the required improvements with no other information other than that provided in the Specifications and Drawings. Plan and profile drawings shall be provided, showing existing and final grades at a scale no greater than 1"= 40' horizontal scale, and 1" = 4' vertical scale. A material take-off, listing the quantities of proposed pipe, manholes, valves, hydrants, etc., shall be provided for bond calculation purposes.
- B. Any Part of the Work which is not mentioned in the Construction Specifications but is shown on the drawings, or any part not shown on the drawings but described in the Construction Specifications shall be furnished and installed by the Contractor as if fully described in the Construction Specifications and shown on the drawings.
- C. All minor details of Work and materials which are not shown on the drawings, as well as such items which are not specifically mentioned in the specifications but are obviously necessary for the proper completion of the Work, shall be considered as incidental, and as being a part of and included with the work.
- D. In case of conflict between the drawings and these Design and Construction Specifications, the Design Standards and Construction Specifications shall govern.
- E. Figure dimensions on drawings shall govern over scale dimensions, and detailed drawings shall govern over general drawings.
- F. Any discrepancies found between the drawings and these Design Standards and Construction Specifications and site conditions or any inconsistencies or ambiguities in the drawings or Design Standards and Construction Specifications shall be immediately reported to the Developer and the District Engineer. The Developer or Developer's Engineer shall promptly have such inconsistencies or ambiguities corrected in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk.
- G. In the event that construction does not proceed within six (6) months of submitting drawings for approval, said drawings, whether approved or not, shall be resubmitted for additional review and re-approval.
- H. Drawings will be reviewed by the District Engineer, and the Project Engineer will be informed of any required corrections or deficiencies. Upon receipt of Approved Electronic sets of drawings not requiring further corrections, the drawings, together with these Design Specifications, become the design upon which all construction shall be based.

General - Drawings shall be prepared on D sized drawings, shall be drawn to scale, and shall provide sufficient detail to allow construction of the required improvements with no information other than that provided in the Specifications and Drawings. Plan and profile drawings shall be provided, showing existing and final grades at a scale no greater than 1"= 40' horizontal scale, and 1" = 4' vertical scale. A material take-off, listing the quantities of proposed pipe, manholes, valves, hydrants, etc., shall be provided for bond amount calculation purposes.

1.5 Water Design Standards

All Water System Installation and design must conform to the Kearns Improvement District Design Standards and Specifications and current AWWA standards.

A. Culinary Pipe Main Standards

1. The pipe diameter used shall be approved by the District Engineer (or his representative) and must adhere to the KID Culinary Water Master Plan.
 - a. The minimum allowable main shall be eight inches (8") in diameter.
 - b. If the Master Plan is not clear in the area about pipe size and location, then the District Engineer shall give final approval.
2. Allowable culinary water pipe material for all projects within the Kearns Improvement District service area shall conform to Section 2.1.
3. Standard centerline alignment within the public right-of-way shall be 10 feet (10') north or 10 feet (10') east of the centerline.
4. Horizontal clearance between a water main and any parallel aligned utility shall be at least 10 feet (10'). When another utility crosses a water line then:
 - a. The other utility shall cross perpendicularly.
 - b. Only dry utilities shall cross above the water main. If this is determined to be unfeasible by the District Engineer, then:
 - i. A minimum of 20 foot (20') long sleeve is required for the sewer line.
 - ii. A minimum of 18 inch (18") vertical separation is required between the two mains.
 - c. If a vertical separation of 18 inches (18") is determined unfeasible by the District Engineer, then:
 - i. A reinforced concrete cradle is required (reinforcement shall meet current specifications).
 - ii. No joints of either utility will be allowed within a 10-foot (10') radius of the crossing.
 - d. If the water line crosses under the sewer line, then a minimum of 20 foot (20') long sleeve is required for the sewer line.
5. The minimum cover required shall be 48 inches (48").
 - a. Cover over utilities and between roadways or rail road tracks shall be sufficient to protect from potential loading either during construction or final finished surface.
 - i. Should cover be insufficient to adequately protect the utility from any loading, encasement or casings shall be provided to protect the affected utility.
6. Pressure Test of the water line is required to hold 225 pounds per square inch (225 psi) test pressure for two (2) hours unless otherwise required.
 - a. If pipe fails the pressure test, locate and repair any defective materials in the line and retest.
 - b. Pressure testing against any valve is prohibited.
7. Tracer wire shall be installed directly above the top of all culinary water pipes.
 - a. Tracer wire shall be 12 gauge insulated copper wire.
 - b. Tracer wire shall be located a maximum of six inches (6") from the top of the main.

B. Disinfection

1. All new waterlines are to be disinfected, and a passing bacteria test obtained prior to connecting to any KID water infrastructure.
 - a. Chlorination of the completed water lines shall be completed by the Contractor at no additional cost to KID.

2. Bacteria samples will be collected by KID Personnel at the request of the KID Inspector.
- C. Culinary Water Trench Standards
1. Compaction tests are required every 200 linear feet at half and full depth for any water main installation. The contractor is responsible for providing test results to KID.
 2. Compaction shall be to 95% or greater relative to a modified proctor density.
 3. If groundwater is encountered, trenches must be kept free from water during excavation, pipe installation, and the installation of material in the pipe zone.
 4. Excavation of any trench must be to OSHA Safety Standards.
- D. Valves
1. Valves shall be located in all intersections and shall equal the number of legs.
 2. All valves larger than 12 inches (12") shall be butterfly design.
- E. Joints
1. Joints shall be restrained at all valves, tees, crosses, bends, wyes, and mega lug fittings.
 2. The number of joints that need to be restrained back from thrust producing fittings shall be determined by the project design engineer. The lengths must also be approved by the District Engineer.
- F. Fire Hydrants
1. Fire Hydrant spacing:
 - a. Shall not exceed 300 feet (300') in areas of multi-family dwellings, commercial and manufacturing uses.
 - b. In single family dwelling use areas hydrant spacing shall not exceed 500 feet.
 - c. All Fire Hydrant location and spacing shall be approved by the district.
 2. Major roads shall have fire hydrants placed on both sides of the roadway staggered every 500 feet to provide Fire Department access to such hydrants.
 3. Hydrants shall be connected to the main using a minimum six-inch (6") diameter pipe.
 4. Permanent dead-end lines shall require a fire hydrant to be installed.
- G. Concrete Thrust Blocks
1. Provide concrete thrust blocks at all taps, temporary dead ends and at the base of all hydrants.
 - a. Place thrust blocks directly against undisturbed earth.
 - b. Provide bond breakers on all thrust blocks.
 2. All other locations shall rely on restrained joints to handle thrust unless directed otherwise by the District Engineer.
- H. Water Vaults/Meter Boxes
1. No meter box shall be allowed in any street, driveway, driveway flare, or sidewalk.
- I. Service Laterals
1. Connection fees for a water tap and meter will be assessed at the time a permit is issued.
 2. No common use laterals shall be allowed.
 - a. Common use laterals shall be eliminated as redevelopment of the site occurs, or if repair or replacement is needed. The construction or repair costs will be the responsibility of the Owner.
 3. Allowable service line shall be constructed as per Section 2.1.
 4. Minimum size shall be one inch (1") diameter for residential connections.
 5. Location of water service shall generally be located 10 feet to 15 feet (10' to 15') from either side property line of the lot being served.
 6. The location of the service line shall be stamped onto the face of the adjacent curb with a "W".
 - a. Location of extended service lateral toward building shall be located via a 2"x 4" with a blue colored end visibly extended above adjacent surface.

7. Minimum static pressure allowed to each individual service shall not drop below 50 psi (50 pounds per square inch) as measured at the water main without approval of the District Engineer.
8. Three (3) piece unions shall not be allowed unless approved by the District Engineer.

1.6 Sewer System Design Standards

- A. Design shall conform to these Design Standards and Specifications.
- B. The design of the sewer system shall comply with all applicable Pretreatment Rules and Regulations.
- C. All sewer lines shall be designed to protect them from freezing.
- D. Unless otherwise approved by the District Engineer, sewer line capacity shall be designed for a peak flow of 400 gallons per capita per day. Sewer line capacity for commercial developments shall be designed based upon a study of actual and projected contributions from existing developed areas and comparable data.
- E. Wherever possible, sewer lines shall be located in public streets. In the locations where sewer lines must leave the public right-of-way, a twenty-foot-wide sanitary sewer easement will be required unless the District Engineer specifies a different width.
 - 1. Easements shall be centered on the sewer line, unless otherwise approved by the District Engineer.
 - 2. Sewer easements shall extend ten feet beyond dead end manholes.
 - 3. Easements shall be shown on the development plat and be granted to the District on the District's Standard Easement form(s).
 - 4. Easements must be executed by or on behalf of all owners and lien holders having an interest in the property, and be returned in recordable form to the District Office prior to final approval being granted.
- F. Manholes and pipes shall be located within a five (5) foot offset from the street centerline, wherever possible. If circumstances warrant and as specifically approved by the District Engineer, manholes and pipes shall be located within the pavement with a minimum distance of five (5) feet required between the edge of the pavement, concrete curb or gutter, and the edge of the manhole collar and pipes.
- G. All sewer lines shall be located a 10-foot minimum horizontal distance from culinary waterlines.
- H. Where possible, sewer shall be located a 10-foot minimum horizontal distance from all other public utilities, including but not limited to storm drains, and secondary waterlines.

- I. Sewer grades shall be based upon Salt Lake County Surveyor or District benchmark elevations.
 1. Gravity Sewer Main lines shall be at least 8 inches in diameter.
 2. Unless otherwise approved by the District Engineer, the minimum sewer slopes shall be as follows:

Pipe Dia (IN)	Min Velocity (V) (FPS)	KID Min Slope Requirement	Max Velocity (V) (FPS)	KID Max Slope Requirement
4	2.00	2.00%	10.00	30.36%
6	2.00	1.00%	10.00	17.69%
8	2.00	0.50%	10.00	12.05%
10	2.00	0.36%	10.00	8.95%
12	2.00	0.28%	10.00	7.02%
15	2.00	0.21%	10.00	5.22%
18	2.00	0.16%	10.00	4.09%
21	2.00	0.13%	10.00	3.33%
24	2.00	0.11%	10.00	2.79%
27	2.00	0.10%	10.00	2.39%
30	2.00	0.10%	10.00	2.07%

3. Unless otherwise approved and/or required by the District Engineer, sewer lines eight (8) through twelve (12) inches in diameter shall be designed to flow no more than half full during peak flow. Sewer lines larger fifteen (15) inches and larger in diameter shall be designed to flow three-fourths full.
4. Mannings Roughness Coefficients for gravity sewer are 0.11 for pvc pipes and 0.13 for rcp pipes.
5. The minimum sewer depth shall be at least 11.0 feet unless otherwise approved by the District Engineer.
 - a. In areas of shallow sewer, the following note shall be written on the development plat: “Shallow Sewer Depths! Contractor shall verify sewer lateral depth and set foundation elevation to provide adequate fall into sewer lateral. Buildings with a basement may not have sewer service available for basement.”
6. A minimum of four (4) feet of cover shall be placed over all main sewer lines, unless additional cover is required by the District Engineer.
7. The invert of new sewer lines shall tie into existing sewer lines at the 0.75 depth point of the existing sewer main; except where otherwise approved by the District Engineer.
8. Sewer Main Lines shall be extended to property lines as per District Engineer’s directive to service future development.
9. Ten-foot sewer stubs shall be extended beyond terminal manholes to facilitate future development.
10. No connections may be made to a sewer stub.
11. Curved sewer, where approved by the District Engineer, shall be designed as follows:
 - a. Sewer shall be constructed of HDPE sewer pipe.
 - b. The minimum radius shall be 150 feet, unless otherwise approved by the District Engineer.
 - c. Installed pipe must be surveyed by a qualified licensed surveyor every 10’ to demonstrate that a 3% slope is maintained.

- d. Surveyed coordinates and elevations shall be submitted to the district, in a format and coordinate system acceptable to the district.
12. In locations with steep pipe slopes (i.e. greater than 15%), pipe shall be constructed of HDPE and concrete anchor restraints shall be installed on the pipe at a spacing and in a manner as indicated on the Standard Detail Drawing SS 10.
- J. Sewer Laterals
- 1. General
 - a. Wherever possible, buildings shall be discharged to the Sewer Main Line with a gravity flow Sewer Lateral.
 - b. Sewer Laterals shall conform to the requirements of the Salt Lake County Department of Health Regulations and the Uniform Plumbing Code.
 - c. Each unit of separate ownership shall be required to have a separate sanitary Sewer Lateral, unless otherwise approved by the District Board of Trustees.
 - d. Sewer Laterals shall have at least four (4) feet of cover, unless otherwise approved by the District Engineer.
 - e. Sewer Laterals may tie directly into manholes.
 - 2. Gravity Sewer Laterals
 - a. The size of Sewer Laterals shall be determined on the basis of the total fixture units drained by such sewer, in accordance with the Uniform Plumbing Code. The minimum size for gravity Sewer Laterals shall be four (4) inches in diameter.
 - b. Sewer Laterals shall be run at a uniform slope of not less than 2% grade. Where it is impractical to run the sewer at a 2% grade due to the depth of the Sewer Main Line.
 - c. Cleanouts shall be installed at not more than 100 foot spacing.
 - d. No more than two (2) bends in excess of 45 degrees will be installed without a cleanout.
 - e. Lateral pipe size shall not be reduced in diameter in the direction of flow.
 - 3. Pressure Sewer Laterals
 - a. Professional advice should be obtained prior to installing pumping equipment or pressure Sewer Laterals.
 - b. In locations where buildings cannot be discharged to the Sewer Main by a gravity flow Sewer Lateral, flows shall be discharged into a tightly covered and vented sump from which the flows shall be pumped by automatic pumping equipment and discharged into a gravity flow Sewer Lateral, connecting at a cleanout, or the Sewer Main, connecting in a manhole with an approved restrained coupling(s).
 - c. Pumping equipment and pressure Sewer Laterals shall be designed to meet or exceed the anticipated use requirements.
 - d. The total maximum system head shall not exceed the pump manufacturer's recommended allowable head for the pump system being proposed.
 - e. Unless otherwise approved by the District Engineer, pressure Sewer Laterals shall be constructed of HDPE.
 - f. Pressure Sewer Laterals shall be sized to provide a minimum velocity of 2.0 feet per second at the design pumping rate.
 - g. Pressure Sewer Laterals shall be designed and constructed on a constant reverse grade.

K. Sewer Casings

1. Sewer casings shall be required at locations where sewer lines cross rivers, streams, canals, aqueducts, railroads, box culverts and/or other locations as required by the District Engineer or other governing authority.
2. Sewer casings shall be sized at least twice the inner diameter of the sewer pipe, unless otherwise approved by the District Engineer.
3. Sewer pipe shall be supported in casing-by-casing insulators and sealed with manufactured end seals.
4. Casing wall thickness shall be as shown on the standard steel casing detail.

L. Sewer Manholes

1. The minimum manhole size shall be 4-foot diameter.
2. Manholes shall be installed at both ends of each main line segment; at all changes in grade or direction (unless a curved gravity flow main line), at changes in pipe type, and at intervals not to exceed 450' for lines 15" in diameter or smaller, or 500' for lines 18" in diameter and larger, unless otherwise approved by the District Engineer.
3. Manholes must be constructed at the ends of sewer lines.
4. Drop manholes are **not** allowed without prior approval of the District Engineer.
5. Where connections are made to existing sewer lines, a minimum five (5) foot diameter manhole shall be constructed over the existing sewer line.

Pipe Diameter	Situation	Manhole Diameter
8" - 12"	5' to 12' deep – Thru Flow	48"
8" - 12"	Intersection of 3 or more pipes	60"
8" - 12"	Where deflection of thru pipe is 45° or greater	60"
8" - 12"	12' to 18' deep	60"
8" - 12"	Connecting into an existing pipe	60"
8" - 12"	12" or greater fall through manhole	60"
15" - 18"	5' to 18' deep – Thru Flow	60"
8" - 30"	18' deep or greater	72"
15"-18"	Where deflection of thru pipe is 45° or greater	72"
21" - 36"	7' deep or greater	72"
15" - 36"	Intersection of 3 or more pipes	72"

6. A minimum of five feet shall be maintained between the edge of all manhole collars and the edge of the street pavement.
7. Unless otherwise approved by the District Engineer, the minimum drops through manholes shall be as follows:

Minimum Drops thru Sewer Manholes	
Angle	Drop Across Manhole
Greater than 90°	0.3'
75° - 90°	0.2'
25° - 75°	0.2'
0° - 25°	No less than grade of downstream pipe

8. In three-way manholes the grade through the manhole shall be designed to ensure that flows will not back up into any of the pipes.
9. The maximum allowable drop between inlet and outlet inverts, through a manhole, is eighteen (18) inches.
10. When incoming slopes at manholes are greater than or equal to 5 percent and the deflection angle within the manhole is greater than or equal to 45°, but less than 90°, a six-foot manhole with an extra deep trough is required.
11. Manholes with pipes 18 inches in diameter and larger and in areas with high hydrogen sulfide potential, as determined by the District Engineer, shall be constructed of corrosion resistant materials, ConShield or Acid-Resistant Polymer Manholes, or approved equal.

M. Sewer Force Mains

1. Force mains shall be designed for a minimum velocity of 2 feet per second at the average design flow.
2. Force mains shall be at least 4 inches in diameter, unless otherwise approved by the District Engineer. Parallel force mains of different diameters will be required to accommodate widely varying flows and contain cleanouts at bends and as approved by District Engineer.
3. Force main piping shall be high-density polyethylene (HDPE) pipe. Minimum wall thickness shall be SDR 11.
4. Force main piping and thrust restraint shall be designed for the design operating pressure of the pump system, including surge pressures.
5. Force mains shall be designed to ensure that there are no high points in the force main.
6. Force mains shall enter the gravity sewer system into a ConShield or Raven 405 manhole, or approved equal, at an elevation not lower than the top of the existing pipe and not greater than 2 feet above the flow line of the manhole and shall be arranged to minimize splashing and turbulence in the manhole.

N. Sewer Lift Stations

1. Lift stations will be permitted only by special approval of the Board of Trustees.
2. These Design Standards apply to lift stations with a capacity up to one million gallons per day (1.00 mgd). Design standards for lift stations larger than 1.00 mgd will be developed on a case-by-case basis by the District Engineer.
3. Lift stations shall be located on a site at least 30 feet by 30 feet in size. Property shall be conveyed by warranty deed to the district. Lift stations shall be located so as to be readily accessible by maintenance vehicles during all weather conditions.
4. Sewer lift stations must remain fully operational and accessible during a 25-year flood. Sewer lift stations shall be protected from physical damage that would be caused by a 100-year flood.
5. The lift station will include at least two submersible pumps. Pumps shall have the same capacity and shall be capable of handling the peak flow with one pump out of service. Pump controls shall provide for alternating operation of the pumps. Pumps shall be specifically designed for submerged operation and shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge piping shall be at least 4 inches in diameter. Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Pumps shall be manufactured by Flygt and shall include Neva-clog or N series impellers. Unless otherwise approved by the District Engineer, lift stations will require three phase power.
6. One automatic flush valve, manufactured by Flygt, shall be required per lift station.
7. One spare pump shall be provided to the district for each lift station, unless otherwise approved by the District Engineer.

8. Pumps and motors shall be sized for the 20-year peak flow.
9. The design engineer shall submit system-head calculations and curves. System-head curves for C values of 100, 120, and 140 in the Hazen Williams equation for calculating head loss corresponding to minimum, median, and maximum water levels shall be developed.
10. A system-head curve for a C value of 120 corresponding to median water level shall be used to make preliminary selection of pump and motor. The pump and motor must operate satisfactorily over the entire range of specified flows for the system-head curves for C values of 100 and 140 corresponding to minimum and maximum water levels intersected by the head-discharge relationship of a given pump.
11. Isolation and check valves shall be placed in the discharge line of each pump. Valves shall be located in a separate vault located near the wet well that is protected from physical damage, weather and freezing, with proper access for operation and maintenance. Isolation valves shall be eccentric plug valves. Check valves shall be ball-check type valves.
12. The dry well hatch shall be sized to allow easy removal and replacement of the pumps. Access hatches shall be Safe-Hatch manufactured by Flygt.
13. The wet well size and level control shall be designed to avoid excessive pump cycling and septic conditions due to excessive detention time.
14. The wet well shall be structurally designed and constructed with a baffle wall system to prevent air entrainment with the pumps and concrete to contain Con Shield Additive. The wet well shall have a locking, rectangular aluminum access hatch or hatches with stainless steel bolts and accessories and shall be sized to allow easy access and cleaning. Access hatches shall be Halliday, Bilco or approved equal and as approved by the District.
15. The valve vault shall include piping, valves and quick-connect couplings to allow bypass pumping from the wet well to the force main using a portable pump.
16. Passive ventilation of the wet well shall be provided. Active ventilation and a Biorem Odor Control system shall be required for the lift station.
17. The accessible portion of the site shall be paved with 8 inches of concrete over 8 inches of compacted road base and non-drivable with 4 inches of concrete over 6 inches of road base.
18. An 8-foot pre-cast wall shall be installed around the perimeter of the site, with a 16-foot black hydraulic vertical pivot gate.
19. Exterior lighting shall be installed at the site.
20. The site shall include a permanent receiving bracket for a portable crane to be used in removing and replacing the pumps.
21. Electrical systems and components (i.e., motors, lights, cables, conduits, switchboxes, control circuits) in wet wells or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class 1, Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided. When such equipment is exposed to weather it shall meet the requirements for NEMA 4X with a stainless steel dead front enclosure and aluminum inner door.
22. Lift station shall include a multitrode level control system, and a backup float set above alarm level manufactured by Flygt.
23. Lift stations shall include remote monitoring equipment with current KID SCADA equipment as required by the District Engineer.
24. Cameras shall be constructed and installed for interior and exterior viewing and be connected to KID network to provide 24-hour surveillance.

25. An alarm system shall be provided that is activated upon power failure, high water level, or another malfunction. Alarms shall be transmitted by an integrated automatic cellular telephone dialer, unless otherwise approved and/or directed by the District Engineer.
26. Lift stations shall be provided with a standby generator. Standby generators shall be diesel fueled. Provisions shall be made for automatic generator start-up and load transfer upon power failure. Standby generators shall be manufactured by Caterpillar or Cummins.
27. The district may require more area when deemed necessary by the District Engineer.
28. Control panels and electrical equipment shall be located in exterior control panels that meet current electrical code requirements.

O. Sewer Flow Meters

1. In locations where KID water meters are not installed or where KID water meters may not accurately represent the amount of flow discharged to the sewer system, a sewer flow meter shall be installed, unless otherwise approved by the District Engineer.
2. Flow meters and control panel shall be installed in a location accessible to the district personnel as shown on the development plans.
3. Power shall be provided by local power provider or solar panels, as necessary.
 - a. Solar Power System shall be designed to provide power during two consecutive cloudy days, including nights, during the wintertime. The system shall be designed to provide continuous power assuming radio transmissions every 20 seconds for 4 second duration.
4. Flow meter site shall include:
 - a. Prefabricated Metering Manhole (48", 60" or 72" diameter as determined in paragraph M above), height as required, with Integral Parshall Flume (throat width determined by flow requirements), as manufactured by Virtual Polymer Compounds or approved equivalent. Manhole body and flume shall be fabricated from molded fiberglass reinforced polyester. Manhole shall include an FRP ladder, mounting brackets for ultrasonic transducer and temperature sensor, and mounting back plate for the open channel flow meter indicator transmitter. Fiberglass grating shall be installed over the channel.
 - b. The open channel flow meter shall be a Siemens (Milltronics) OCM III wall mounted indicator transmitter, housed in a NEMA 4X enclosure complete with one weatherproof power outlet, located on a pole next to the metering manhole. System includes an XRS-5 non-contacting ultrasonic level sensor, TS-2 temperature sensor for automatic temperature compensation and a removable handheld programmer. An internal data logger, 4-20 mA signal output and (3) programmable dry contact alarm relays shall also be included. The system operates on 110 VAC single phase power.
 - c. Communications shall include:
 - i. Radio: GE MDS INET 900 IP radio with PCTEL Maxrad 710-970 MHz Yagi Antennas and all required connectors and cabling. Cable shall be ½" Heliac Times Microwave LMR-600 or equal.
 - ii. PolyPhaser IS-50NX-C2-MA Lightning Protector or equal. The lightning protector shall be bulkhead mounted on the antenna cable entrance into the equipment enclosure.
 - iii. A grounding kit Wireless Solutions WGK-U2H5-UT or equal.

P. Grease and Sand/Oil Interceptors

1. A grease interceptor, oil separator or sand interceptor, located outside the facility or building, shall be provided as part of the Private Lateral Wastewater line of any commercial, industrial, and institutional facility or building that has the potential of introducing substances that would be detrimental to the Sewer Treatment Facility or Collection System, as determined by the District according to the KID Pretreatment Program.
2. All wastewater from “FOG” (Food, Oil, Grease) -bearing fixtures must be routed to the Interceptor.
3. All Interceptors shall be installed and located so as to be readily accessible for cleaning by the User and inspection by KID employees. Interceptor access manholes should not be located in parking spaces or near the entrance or exit of a building.
4. All interceptors shall be constructed of impervious materials capable of withstanding abrupt and extreme changes in temperature. They shall be of substantial construction, watertight and equipped with easily removable covers which are gas and watertight.
5. The working capacities of Interceptors connected to the district’s sewer system must be at least 1000 gallons, but no more than 2000 gallons. Interceptors must be sized to provide a minimum hydraulic retention time of 30 minutes. This is calculated by multiplying the maximum peak wastewater flow in gallons per minute times 30 minutes.
6. Interceptors shall be precast concrete and have a minimum of two compartments.
 - a. The basic configuration and dimensional characteristics of a typical Interceptor are shown in Drawing SS 5.
 - b. In a two-stage interceptor, the first (upstream) compartment should be approximately twice the liquid volume of the second (downstream) compartment.
 - c. The intermediate baffle(s) must extend the full width of the Interceptor, and from the bottom to within three (3) inches of the top.
 - d. The design and construction of the interceptor must ensure that there is no flow between compartments around the bottom or side edges of the baffle(s).
 - e. The Interceptor must be sealed to prevent leakage to or from the adjacent soil.
 - f. Interceptors shall be engineered to withstand anticipated surface loads such as vehicular traffic.
 - g. Interceptors shall be vented through a vent stack, through the inside of the building to the roof, independent from other vents and away from any air intake on the roof.

Q. Sampling Manholes

1. A sampling manhole is required downstream of all Grease and Sand/Oil Interceptors and upstream of any sanitary sewer connections.
2. Sampling manholes shall be five (5) feet in diameter.
3. The depth and width of the manhole trough shall be equivalent to the inlet pipe.
4. The invert of the inlet pipe shall be at least 3 inches above the trough through the manhole.

R. Construction Drawings

The Construction Drawings shall include the following information:

1. Street names and widths.
2. Subdivision lot numbers
3. Street centerline stations and property line stations; plan stations must agree with profile stations.
4. Drawing scale
5. North arrow
6. County or District benchmark elevations
7. Roadway centerline finished grades, or if in an easement the finished grade above the utility line.
8. Top of curb finish grades at property lines.

9. Finish grades at manhole locations with top of rim elevations shown.
10. Sewer line pipe size, type, and class.
11. The following notes:
 - a. “Contractor shall field verify locations and invert elevations of existing utilities before staking or constructing any new KID utility lines.”
 - b. All construction shall comply with the Kearns Improvement District Design Standards and Specifications.”
12. Commercial plans shall have the following note: “Four feet of cover is required over all sewer and water lines.”
13. Commercial subdivision plats, to be signed prior to utility plans being approved, shall have the following note written on them: “The signature of the Kearns Improvement District on this plat does not constitute any guarantee of availability of water and sewer service to the property or any approval of utility line or facilities. The owner(s) of the property must provide satisfactory plans to the Kearns Improvement District for review and approval before connecting to the district’s utility system and will be required to comply with the district’s rules and regulations.”
14. Any potential conflicts between new utility lines and all other existing utilities, including but not limited to sewer lines, culinary water lines, secondary water lines, and/or storm drains shall be noted in the drawings.
15. Dimensions to sewer lines from monument lines or property lines shall be shown.
16. “Match to Drawing” notes shall refer reader to adjacent drawings.
17. Connecting utility lines shall be labeled as existing or proposed.
18. Drawing shall be designed, signed and stamped by a professional licensed engineer.
19. Construction Drawings shall include a signed dedication plat.
20. Construction Drawings shall include a final grading plan.
21. Construction drawings shall contain plan and profile views of all sewer main lines. Profile views shall show existing and final surface profiles.

1.7 As-built (Construction) Drawings

- A. Upon completion of the work, the Engineer shall prepare a set of AS-BUILT Drawings which incorporate all field changes. Upon approval and acceptance of the AS-BUILT Drawings, and as a condition of bond reduction, the Engineer shall provide a PDF and Auto-CAD, electronic means, to KID suitable for incorporation into KID's GIS System.
- B. Two dimensional ties are required to the 2x4 lateral markers. These ties shall be from the two front property corners, or a "nail-in-curb" projected from the property corner, from the same side of the roadway, unless other points of reference are specifically approved by the District Engineer.
- C. Stationing at all laterals and manholes is required to be shown with regard to actual field conditions.
- D. Any changes differing appreciably from the approved design drawings (i.e. sewer line and manholes relocated to opposite sides of roadways; sewer line shortened or lengthened 5 feet or greater; invert elevation changes) shall be shown graphically correct to reflect field conditions.
- E. All items shown on the profile, including slopes, inverts, and lengths, are required to be changed to reflect field conditions. These items are also required to be shown correctly graphically.
- F. The Engineer shall certify, to the best of his/her knowledge and available information, which has been incorporated into the AS-BUILT Drawings that all construction and procedures have been completed in general accordance with KID Final Design Approved Drawings and any approved revisions. The Engineer shall provide his/her stamp and signature on all AS-BUILT Drawings.
- G. The AS-BUILT Drawings shall include all sheets which comprise the original set of Drawings.
- H. Type and size of pipe installed shall be indicated on the AS-BUILT Drawings.
- I. The location of "as-built" sewer and water lines within easements or platted Rights-of-way shall be verified. If revised easements are required, they shall be obtained by Developer, in form and substance acceptable to KID, and be filed for record with the Salt Lake County Recorder. A copy of all required recorded easements shall be submitted with the AS-BUILT Drawings.
- J. "As-built" or final manhole rim elevations are not required to be presented on the AS-BUILT Drawings.
- K. Any pertinent field information obtained by the Contractor shall be required to be shown on the AS-BUILT Drawings.
- L. Construction Drawings
 - 1. The Construction Drawings shall include the following information:
 - a. Street names and widths.
 - b. Subdivision lot numbers
 - c. Street centerline stations and property line stations; plan stations must agree with profile stations.
 - d. Drawing scale.
 - e. North arrow.
 - f. County or District benchmark elevations.
 - g. Roadway centerline finish grades or, if in an easement, the finished grade above the utility line.
 - h. Top of curb finish grades at property lines and at hydrant locations.
 - i. Finish grades at valve locations.
 - j. Finish grades at air/vacuum assembly locations.
 - k. Water line pipe size, type, and class.
 - l. The following notes:
 - i. "Contractor shall field verify locations and invert elevations of existing utilities before staking or constructing any new KID utility lines".
 - ii. "All construction shall comply with the Kearns Improvement District Design Standards and Specifications."
 - m. Commercial plans shall have the following note: "Four feet of cover is required over all sewer and water lines."

- n. Commercial subdivision plats, to be signed prior to utility plans being approved, shall have the following note written on them: “The signature of the Kearns Improvement District on this plat does not constitute any guarantee of availability of water and sewer service to the property or approval of any utility line or facilities. The owner(s) of the property must provide satisfactory plans to the Kearns Improvement District for review and approval before connecting to the district’s utility system and will be required to comply with the district’s rules and regulations.”
2. Any potential conflicts between new utility lines and all other existing utilities, including but not limited to culinary water lines, secondary water lines, and/or storm drains shall be noted in the drawings.
3. Dimensions to water lines from monument lines or property lines shall be shown.
4. “Match to Drawing” notes shall refer reader to adjacent drawings.
5. Connecting utility lines shall be labeled as existing or proposed.
6. Drawing shall be designed, signed and stamped by a professional licensed engineer.
7. Construction Drawings shall include a signed dedication plat.
8. Construction Drawings shall include a final grading plan.
9. Construction Drawings shall contain plan and profile views of all sewer main line. Profile views shall show existing and final surface profiles.

1.8 Easements

- A. The Developer shall obtain with the district’s easement forms, review and approval of easements by the district for all land and rights-of-way necessary for carrying out and completing the Work to be performed pursuant to the approved Drawings and Specifications, unless otherwise mutually agreed. The requirements of the Utility Extension Agreement shall prevail in all such matters.
- B. The Developer shall record the subdivision plat with the County Recorder, which plat shall indicate all easements and rights-of-way necessary for the installation of the Project improvements. A Mylar copy of the plat shall be submitted to KID with the electronically approved design drawings.
- C. The Developer shall provide to the Contractor with information which delineates and describes the lands owned, and rights-of-way and easements acquired. Copies of the easements and permits that have been acquired by the Developer will be available to the Contractor.
- D. The Developer shall obtain any other off-site easements with the District’s easement forms, review and approval by the District and record with the County Recorder, easements that are required to complete the Project, without liability to KID, and provide a pdf copy and electronic copy in Auto-CAD of the recorded easements to KID before bond reduction. Such easements shall be clearly in favor of KID, allowing access for maintenance, repair, excavation, etc., and shall be submitted in Auto-CAD drawings.
- E. It shall be the Contractor’s responsibility to determine the adequacy of the easements obtained in every case and to abide by all requirements and provisions of the easements.
- F. The Contractor shall obtain and provide without liability to the district any additional land, access and easements thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.
- G. Easements shall be of sufficient width to allow for maintenance, repair, and replacement of the improvements installed there in.
- H. The required easements and access permits shall be obtained before a pre-construction meeting is held.
- I. Trees shall not be allowed within proposed easements.

Easements Required for KID Utility Installation Projects

(All Numbers are in Feet)

Any Deviation from the following must be approved by the KID General Manager. Trees are not permitted in new construction easements.

Pipe Size	8” – 12”			15” – 18”			21”- 27”			30” – 36”		
	Right of Way Width	Construct. Easement	Total Width Req’d	Right of Way Width	Construct. Easement Width	Total Width Req’d	Right of Way Width	Construct. Easement Width	Total Width Req’d	Right of Way Width	Construct. Easement Width	Total Width Req’d
0-6	15	15	30	20	10	30	25	5	30	25	10	35
6-8	15	20	35	20	15	35	25	10	35	25	10	35
8-10	15	20	35	20	15	35	25	15	40	25	15	40
10-12	15	25	40	20	20	40	25	15	40	25	20	45
12-14	15	25	40	20	25	45	25	20	45	25	20	45
14-16	15	30	45	20	25	45	25	25	50	25	25	50
16-18	15	35	50	20	30	50	25	35	55	25	30	55
18-20	15	40	55	20	35	55	25	30	55	25	35	60

1.81 **Easement Sample:** Contact KID Engineering for the latest example of an Easement Grant.

Easement Sample (Reserve Page)

Easement Sample (Reserve Page)

1.9 Pre-Construction Meeting Agenda

PRECONSTRUCTION MEETING AGENDA

Project:	
Location:	
Date:	
Meeting Location:	5350 West 5400 South, Kearns, UT
Time:	
Developer:	
Contractor:	
Project Engineer:	
KID Support Services Manager:	
KID Inspector:	

ATTENDING

NAME	REPRESENTING	TELEPHONE No.	EMAIL

MAIN AGENDA ITEMS

1. The KID Inspector will provide an Inspection Report to the contractor for each visit. If a KID Inspector is not present, at least once each day work is performed, the Contractor is to call for an inspection. Call the KID Inspector. If he is unavailable, please call the office at 801-968-1011.
2. The approved plans and KID Design Standards are to be available on site. Electronic pdf forms are acceptable.
3. It is critical that the pipe bedding and backfill follow District specifications. Compaction testing is required by the Developer and results shall be regularly submitted, reviewed and approved by the District Engineer.
4. Any deviations from the approved plans must be reviewed and approved by the District Engineer prior to construction.
5. The Contractor is to conduct pressure tests for the pipes, video log the sewer line, and request bacteria tests by the district as outlined in the Design Standards.
6. The Project Engineer is to provide “AS-BUILT” drawings in PDF and Electronic Auto-CAD format. A Bond / Letter of Credit Guarantee reduction will not be considered without this item.
7. If required, discussion of Hazardous Material Handling (See Section 1.17)
8. Construction Water- Contractor will be required to set up an account, a deposit for a fire hydrant meter. The contractor shall use hydrants in strict accordance with KID requirements for hydrant use and shall provide backflow or air gap protection.
9. Other Items:

1.10 Development Process
KEARNS IMPROVEMENT DISTRICT

In order to assure proper receipt and release of bonds, the following procedures are to be followed:

- A. The plans are to be reviewed by the district to determine compliance with KID Design Standards. The applicant is provided and shall comply with KID current Design Standards and.
- B. Based on the approved plans, the District Engineer and Staff will calculate the required fees associated with the project and provide the appropriate agreement forms. Easements will need to be submitted on District approved forms and approved.
- C. A pre-construction meeting will be scheduled after the fees are paid, forms and easements are submitted and approved. The district will hold a pre-construction meeting to review the project, scope and Design Standards required by the contractor to follow during construction. Inspection procedures will be outlined and any changes to the approved plans must be reviewed and approved by KID before implementation.
- D. The district will perform inspections on a regular basis and the contractor will need to coordinate with the Inspector. An electronic record of all inspections will be kept by the district. For any violations, the Inspector will stop work until corrections are completed and acceptable to the district.
- E. The district will perform an inspection and provide a punch list of items for the Contractor to complete. The Contractor will be required to video the sewer line and provide an electronic copy of the video to the district. The district will inspect the air test, hydrostatic tests, and collect samples for the bacterial tests. The Contractor will correct any deficiencies. The district will confirm that these corrections and submittals are complete.
- F. The Contractor shall provide As-built drawings (electronic) in PDF and Auto-CAD format to the district. They will be reviewed and approved by the district.
- G. Once the As-builts are accepted, the district will provide the developer an estimate to post a ten percent (10%) Bond / Letter of Credit Guarantee which will be held as a warranty for a period of twelve (12) months to guarantee the workmanship and materials of the installation.
- H. If deficiencies in materials or workmanship are found during the twelve (12) month warranty period, the Contractor will be required to correct them at the Contractor's expense. If the District makes the correction either because it was an emergency situation, and water or sewer service to the residents might be interrupted, or because the Contractor has failed to respond to a reasonable request to correct the deficiency, District will retain a portion of the Bond/Letter of Credit Guarantee to cover the expenses incurred. The district will maintain records of the expenses related to such repairs.
- I. After the twelve (12) months of the warranty period and weather permitting, the district will complete a final inspection. The district will provide a punch list of items to be completed by the contractor. Upon correction of the deficiencies, the district will review and prepare a request for the KID Board of Trustees to release the Bond / Letter of Credit Guarantee at the next regularly scheduled Board meeting. The district will send a letter to the bonding agency requesting a release of the bond.
- J. After the final inspection, the district will assume full responsibility for the Project improvements.

The following is a list of items that will be inspected or must be completed prior to approvals. The list is not intended to cover every item or issue but is to be used as a guideline together with good workmanship.

Waterline	
1.	Proper Depth and Size & Material
2.	Properly bedded and backfilled
3.	Disinfected
4.	Flushed
5.	Chlorinated
6.	BT Sample taken
7.	Thrust blocks as required
8.	Pressure Test
Fire Hydrants	
1.	Plumb & proper elevation
2.	Proper orientation
3.	Concrete pad
4.	Bolt accessible
5.	Thrust block
6.	Auxiliary valve in street
7.	Gasket seating
8.	Flushed
Meter Boxes	
1.	Located in park strip (not driveway)
2.	Level with curb
3.	Meter set at 18” – 20” below lid
4.	Box supported by 12x6x1 pavers
Water Valves	
1.	Set level with lids
2.	Clean
3.	Workable
4.	Concrete collar at grade
Sewer Manholes	
1.	Set to grade
2.	Manhole grouted and clean
3.	Lifting holes grouted
4.	Steps in manhole
5.	Debris and boards removed
6.	Grade rings grouted
7.	Concrete collars around manholes
Sewer Lines	
1.	Proper elevation and alignment
2.	Properly bedded and backfilled
3.	No bellies
4.	Laterals connected in 10:00 O’clock or 2:00 O’clock position
5.	Sewer line video data provided

6.	Air tested
7.	Flushed and rocks and debris removed
8.	Sewer line mandrel test results

1.11 Coordination of Work

- A. The Contractor shall review the drawings and specifications and shall report any discrepancies to the District Inspector and obtain from him written instructions for necessary changes.
- B. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the District Inspector. All changes required in the Work of the Contractor caused by Contractor's neglect to do so shall be made by Contractor at Contractor's own expense.

1.12 Changes / Corrections in the Work

- A. KID may at any time as the need arises, order changes in the scope of the work. If such changes increase or decrease the amount due under the agreement between the Developer and the Contractor, an adjustment shall be worked out between the two parties.
- B. The developer shall ensure that such corrections or repairs as may be necessary by reason of any defects, including the repairs of any damage to other parts of the Project resulting from such defects, are promptly made without any cost to KID.
- C. The district may at any time, by issuing a field order, make changes in the details of the Work. If such changes increase or decrease the amount due under the agreement between the Developer and the Contractor, an adjustment shall be worked out between these two parties, unless otherwise mutually agreed to by KID and the Developer and/or the Contractor.
- D. When the Developer or Contractor requires change(s) in the Work, said change(s) shall be submitted for review by, and approved by, the District Engineer prior to construction of said changes. Proposed changes in the Work shall conform to these Design Standards and Construction Specifications. If such changes increase or decrease the amount due under the agreement between the Developer and the Contractor, an adjustment shall be worked out between these two parties, unless otherwise mutually agreed to by KID and the Developer and/or the Contractor.
- E. The Contractor shall promptly remove from the premises all Work rejected by the District Engineer for failure to comply with the approved Plans and Specifications whether incorporated in the construction or not, and the Contractor shall promptly replace and re-execute the Work in accordance with the approved Plans and Specifications.
- F. All removal and replacement Work shall be done at the Contractor's expense.
- G. The District Engineer shall have authority to cause further Work to be suspended or stopped until remedial action on substandard work has been undertaken and/or completed.

1.13 Testing Requirements

- A. Developer and/or Contractor shall employ and pay for services of an independent testing or inspection agency to perform specified services and follow local requirements for compaction testing.
- B. Employment of such agency in no way relieves Contractor of any obligation to perform Work in accordance with requirements of the Construction Specifications.
- C. Contractor and Developer Employed Agency: Testing agency, Inspection Agency, Laboratory, Staff and Testing equipment shall comply with requirements of ASTM D 1557 American Society for Testing and Materials for Modified Proctor Density or according to local permit.
- D. District reserves the right to hire an independent testing firm(s) to perform test(s) the district determines to be necessary.
- E. Quality Control - Contractor shall:
 - 1. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of a specified quality.
 - 2. Comply with manufacturers' instructions, including undertaking each step in sequence.
 - 3. Request clarification from District Inspector before proceeding, should manufacturers' instructions conflict with Design Standards or Construction Specifications.
 - 4. Comply with specified standards as to minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
 - 5. Have Work performed by persons qualified to produce required and specified quality.
 - 6. Verify that field measurements are indicated on shop drawings or as instructed by the manufacturer.
 - 7. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.
- F. Tolerances - Contractor shall:
 - 1. Monitor fabrication and installation tolerance control of products to produce acceptable Work.
 - 2. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with these Construction Specifications, request clarification from District Inspector before proceeding.
 - 3. Adjust products to appropriate dimensions; position before securing products in place.
- G. See individual Construction Specifications for required testing.
- H. Testing Agency Duties:
 - 1. Submit Material Mix designs with gradations to District for review and approval that meets the Districts Standards and Specifications. Receive approved material designs by District before transporting material. District reserves the right to inspect the source location of materials.
 - 2. Provide qualified personnel at site. Cooperate with District Inspector and Contractor in the performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Promptly notify District Inspector and Contractor of any observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by District Inspector.

6. Attend pre-construction meetings and progress meetings, when requested.
 7. Submit reports of all test/inspections specified.
- I. Test Reports: After each test/inspection, promptly submit electronic PDF copies of the report to the District Inspector and to Contractor; within maximum of 24 hours.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location of the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with the Construction Specifications.
 - k. When requested by the District Inspector, provide interpretation of results.
 2. Test reports are submitted for the District or District Inspector's knowledge, for information and for the limited purpose of assessing conformance with information given and the design concept expressed in the Construction Specifications.
- J. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Design Standards and Construction Specifications.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- K. Contractor Responsibilities:
1. Deliver to testing agency, at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel and provide access to the Work.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at the source of products to be tested/inspected.
 - c. To facilitate testing/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify District Inspector and laboratory at least 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for samples, tests, and inspections required by District specified requirements.
 6. Arrange with testing agency and pay for additional samples, tests, and inspections required by the District if necessary.
- L. Re-testing required because of non-conformance to specified requirements shall be performed by the same testing agency on instructions from the District Inspector. The district shall not be responsible for the costs of any re-testing.

M. Manufacturers' Field Services

1. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable and to initiate instructions when necessary.
2. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.14 Bonds/Warranty

- A. Except for those portions of the Project installed in any fill area as defined herein, the Developer shall warrant and guarantee for a period of one (1) year from the date of final acceptance of the Work by KID (the “Standard Warranty Period”) that the completed Project is free from all defects due to faulty materials and/or workmanship.
 - 1. It is hereby expressly understood and agreed that KID shall not finally accept the Work before the expiration of the Standard Warranty Period, and then only in the case that all necessary repairs have been made according to standard methods approved by the District Engineer.
 - 2. A ten (10) percent retainage of the Bond/Letter of Guarantee shall remain in full force and effect through the Standard Warranty Period and until the conditions of the warranty are fulfilled.
- B. The developer shall ensure that such corrections or repairs as may be necessary by reason of any defect, including the repairs of any damage to other parts of the Project resulting from any such defect, are promptly made without any cost to KID.
 - 1. The district will give notice of observed defects with reasonable promptness.
 - 2. In the event that the Developer should fail to make, or cause to be made, such repairs, and adjustments, or to perform other Work that may be made necessary by such defects, KID may do so and charge the Developer the cost thereby incurred.
- C. Developer shall provide all warranty documentation for all equipment installed during the Work, including pumps, controls, and hatches. Except for items put into use with KID’s permission, the warranty period does not commence until the district’s final acceptance of the Project is obtained.
- D. The determination of the necessity for repairs required under this Subsection rests entirely with KID, whose decision shall be final and obligatory upon the Contractor.
- E. If warranty work is performed, a new warranty period should start for the warranty work.

1.15 Surveying

A. Developer's Responsibilities

1. The Developer or Developer's Engineer shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the Work together with a suitable number of benchmarks adjacent to the Work, as indicated in these Design Standards and Construction Specifications.
2. The Developer's Engineer shall furnish alignment and grade data in the form of offset stakes or markers located a convenient distance from the centerline of the pipe, structures, etc., and referenced to the centerline of the Work.
3. Line and grade stakes shall be provided at sewer manholes and boxes for laser instrument setting and at a distance of 50 feet therefrom to check the setting. KID requires the use of laser instruments for the installation of sewer lines and appurtenances. No string lines will be used, unless otherwise approved by the District Inspector. The Contractor shall be responsible for establishing additional control stakes, as required.
4. Prior to commencement of work under the Project, the Developer shall establish lot corner stakes showing plan and elevation references to curb and gutter and sidewalks.
5. Offsets to water lines and appurtenances in subdivisions shall be referenced from lot corner or curb and gutter stakes. For water line extensions beyond the Project boundaries or in any development other than subdivisions, line stakes shall be provided at valves, bends, hydrants, and at intervals of not to exceed 100 feet.
6. Structures. A maximum of eight (8) line and grade stakes shall be provided for each rectangular or square structure.
7. KID may check the alignment and grades of the various parts of the Work from time to time, if deemed necessary.
8. The Contractor shall, without additional costs, give such assistance and provide such ladders, lights, and other equipment as may be required in establishing and checking lines and grades.
9. KID will not be responsible for surveys conducted by others.
10. Upon completion of the Project, the new water/sewer lines, valves, manholes, etc. shall be surveyed to ensure that all utility lines and components are installed within the public right(s)-of-way or recorded utility easements, and that the edge of valve/manhole collars are located in approved locations away from edge of pavement or curb and gutter.

B. Contractor's Responsibilities

1. Verify locations of survey control points prior to starting Work.
2. Promptly notify the District Inspector of any discrepancies discovered.
3. The contractor shall locate and protect benchmarks, survey monuments, reference points, control stakes and survey control points.
4. Control datum for survey that is indicated on Drawings.
5. Protect survey control points prior to starting site Work; preserve permanent reference points during construction.
6. Promptly report to District Inspector the loss or destruction of any reference point or relocation required because of any change in grades or other reason.

7. Developers' surveyor will replace dislocated survey control points based on original survey control and make no changes without prior written notice to District Inspector, including:
 - a. Utilize recognized engineering survey practices.
 - b. Establish elevations, lines, and grades. Which are located and laid out by instrumentation and similar appropriate means.
 - c. Periodically verify layouts by same means.
 - d. Finish grade elevation for manholes, fire hydrants, etc. shall be transferred from property corners and curb elevations, or as directed by the District Inspector.
 - e. Maintaining a complete and accurate log of control and survey work as it progresses.
8. The Contractor shall transfer line and grade from the stakes or marks referred to above, to the Work and shall be responsible for the accuracy of the measurements from the stakes or marks to the Work.
9. The Contractor shall be responsible for the accuracy of all stakes for alignment and grade established by the Contractor. However, KID shall have the discretionary right to check the Contractor's stakes alignment and grades at any time.
 - a. Survey stakes, marks, grades, etc. set by the Contractor shall be established far enough ahead of their use so that KID has at least 24 hours during normal working time to check the Work prior to use by the Contractor.
 - b. The Contractor shall notify the District Inspector when the Work is ready to be checked. Over time costs and other cost incurred by KID to accelerate the schedule for the Contractor's convenience shall be charged against the Contractor
 - c. The Contractor shall be responsible for the protection of all control stakes established by the Developer's Engineer or KID.
 - d. The Contractor shall not disturb any survey monuments found in the line of the Work unless written authority to do so is given by the District Engineer. All costs incurred by KID in replacing monuments that have been disturbed by the Contractor without written approval shall be paid by the Contractor.

1.16 Emergencies

- A. Emergencies may arise during the progress of the Work which may require special effort or require extra shifts or personnel to continue the Work beyond normal working hours. The Contactor shall be prepared, in case of such emergencies from whatever cause, to do all necessary work promptly.

1.17 Hazardous Materials

- A. If the Contractor, during the course of work, observes the existence of any hazardous material, including but not limited to asbestos pipe, chemicals, or gasoline, the Contractor shall promptly notify the Developer and the District Inspector. The Developer and the District Inspector shall consult regarding the removal or encapsulation of the hazardous material and the Contractor shall not perform any Work pertinent to the hazardous material prior to receipt of special instructions from the Developer and the District Inspector. All handling and removing of hazardous material shall be handled by qualified and certified personnel complying with the State of Utah and OSHA Standards and requirements.

1.18 Permits, Regulations, and Fees

- A. The Contactor shall give all notices and comply with all laws, ordinance, rules and regulations bearing on the conduct of the Work as drawn and specified.
- B. If the Contractor observes that the Specifications and Drawings are at variance therewith, he shall promptly notify the District Engineer in writing.
- C. Permanent easements and rights-of-way shall be secured by the Developer, as described in subsection 1.8.
- D. All required District fees must be paid to KID prior to commencement of any Work.
- E. All required permits, licenses, both governmental and authoritative shall be secured prior to commencement of any Work.
- F. Permits, and licenses, and approvals of a temporary nature necessary for the prosecution of the Work shall be secured and paid for by the Contractor.

SECTION 2 WATER SPECIFICATIONS

2.1 Water Systems Material Summary Table

Water Works

	ITEM	DESCRIPTION	MANUFACTURER	MODEL
PIPE (Must be NSF approved)				
	4" to 10" PVC	C-900 Class 305 (DR 14) or Class 235 (DR18)	JM Eagle, Vinyl Tech, North American Pipe	
	Ductile Iron Pipe 12" to 30"	Class 52 or Pressure Class 350 psi, AWWA C151 with Push on Joints, AWWA C111 Rubber Gasket Joints	American Ductile Iron, Pacific States Cast Iron Pipe, U.S. Pipe	
	½" to 3" PEX CTS (SDR-9) Poly Pipe	AWWA C904-06 Cross-Linked Polyethylene (PEX) Pressure Class 160psi		
	Copper Tubing	Type K, ASTM B88 Table 3, "Dimension, Weight, and Tolerances," Capable of Connecting to AWWA Standard Water Service Taps and Fittings	Cerro Flow Products, Mueller, or approved equal	
	Mega Lug Followers	Approved by District Engineer		
VALVES (4" and Larger)				
	Butterfly Valves	12" to 48", Cast Iron Body, Bronze Mounted. Conform to requirements of AWWA C504-10	Mueller, Clow, American	Line Seal III, Style 4500 & 1450 Series 2500
	Gate Valves	4" to 12", Resilient Wedge, Cast Iron Body, Bronze Mounted. Non-Rising Stems with "O" Ring Seals Conform to requirements of AWWA C504. Open Counterclockwise.	Mueller M&H American	A-2360 Style 7000 Series 2500
VALVES (3" and Smaller)				
	Gate Valve	2"-3" Resilient Wedge follow AWWA specifications	Mueller American Clow	Series 2360 Series 2500 Model 2639
	Ball Valve	¾" to 2" conform to AWWA regulations	Ford Meter Box Mueller	Model B11 Mueller 300
	Corporation Stop	Follow AWWA specifications	Ford	N/A
	Compression Angle Valve	Follow AWWA specifications	Ford	N/A
	Corporation Valves	Follow AWWA specifications	Ford	N/A
	Angle Meter Valve	Follow AWWA specifications	Ford	N/A
	Curb Valve	Follow AWWA specifications	Ford	N/A

CHECK VALVE (Outside Weight and Lever Required)				
	Valves 2 ½" and Smaller	200 psi Working Pressure, Y-Pattern, Bronze, Regrinding, Swing Check Valve with Screwed Ends Follow AWWA specifications		
	Valves 3" and Larger	Iron Body, Bronze Mounted, Silent Check Valves, Flanged Ends, Swing Valves with Stainless Steel Hinge Pins Follow AWWA specifications		
FIRE HYDRANTS (AWWA C502)				
	Standard Fire Hydrant	High Pressure Dry Barrel, 5 ¼" Valve Opening. Operating Cap and Nuts: Pentagon 1 ½" Point to Flat Follow AWWA specifications	Mueller Clow Or Approved Equal	Centurion Model F2500
	Pipe and Fittings	6" Ductile Iron, PVC Follow AWWA specifications	See Pipe Section	
	Gate Valves	6", Resilient Wedge, Cast Iron Body, Bronze Mounted. Non-Rising Stems with "o" Ring Seals. Conform to requirements of AWWA C504, Open Counterclockwise.	Mueller M&H American Or Approved Equal	A-2360 Style 7000 Series 2500
BACKFLOW PREVENTER				
	RP Backflow Device	Reduced Pressure Backflow Device as Approved by the State of Utah Division of Drinking Water		
METERS (KID will Provide and Install Meters)				
	¾" – 2"	Typical Service Meter	Neptune	
	3" – 6" Compound	For wide flow rate applications	Neptune	Mach 10 Ultrasonic
	6"- 8" Fire Services	Specified for fire service fed from a single line	Neptune	HP Protects III SS Fire Service Meter
	3"- 8" HP Turbine	For Moderate to High Flow Rate Applications	Neptune	Mach 10
PIPE FITTINGS				
	Service Fitting	Compression Connection Follow AWWA specifications	Ford	110 Compression
	Ductile Iron Fittings	Tees, Class 250 AWWA C110	American Ductile Iron Clow U.S. Pipe Or Approved Equal	
	Ductile Iron Fittings	Bends, Reducers, and End Caps, Class 250, AWWA C110	American Ductile Iron Clow U.S. Pipe Or Approved Equal	
	1.5" – 24" Coupling	Coupling and Repair Clamp, AWWA C-219, AWWA C-230, NSF-372, and NSF-61	Versa-Max	

	6" – 30" Ductile Iron Fittings	Mechanical Joint Connection Follow AWWA specifications	One Lok Or Approved Equal	Mechanical Joint SLDE Wedge Restraint Gland Pak
	6" – 10" PVC Fittings	Mechanical Joint Connection Follow AWWA specifications	One Lok Or Approved Equal	Mechanical Joint SLCE Wedge Restraint Gland Pak
	6" – 30" Ductile Iron Fittings	Gasket per ANSI/AWWA C111/AR111	U.S. Pipe Or Approved Equal	Tyton Gasket
	Copper Fittings	45° & 90° Copper Fittings, Per AWWA C800. AWWA C110		
	Copper Fittings	Service Connections, Type K, with Flare 200 psi Compression Fittings, per AWWA C800		
VAULTS				
	Pre-Cast Vault	Per Standard Drawing	AMCOR Old Castle Dura-Crete	
	Meter Box 2"	4' x 4' Precast Concrete Box		
	Meter Box 1" or less	18" for ¾" meter 21" for 1" meter		
	Vault Ladder		Anything larger than a 4' x 4' box	
LOCATING WIRE TAPE				
	Wire	12 Gauge Insulated Copper		
	Wire Splice	Direct Bury (DBR) Splice Kit		
	Warning Tape			
COVERING / LIDS				
	Valve Cover	8" Outside Diameter, Cast Iron, "Water" should be Cast on the Cover		
	Meter Box Cover	24" Cover with Inset Lid	The Ford Meter Box Company, Inc.	
	Standard Vault Lid	H-20 Load Rating		
	Traffic Rated Vault Lid	H-20 Load Rating		
	Valve Box: Buried in Traffic Areas	2 Piece, Cast Iron, Slip Type, Class 35 Heavy Duty, 5 ¼" Shaft with a Drop Lid	C.I. – 562A vb or Approved Equal	
	Valve Box: Buried in Non-Traffic Areas	2 Piece, Cast Iron, Slip Type, Class 35 Heavy Duty, 5 ¼" Shaft with a Drop Lid	C.I. – 562A vb or Approved Equal	
FIRE SERVICES				
	DDC	Reduced Pressure Backflow Device	Neptune	
	Combo Fire & Domestic		Neptune Or approved Equal	
MISCELLANEOUS				
	Bolts	Stainless Steel, American Standard Machined Heavy Hexagon Heads		

		with Class 2 Fit and Threads. ASTM A325 (1/2" to 1 1/2")		
	Anchor Bolts	Stainless Steel, American Standard Machined Heavy Hexagon Heads with Class 2 Fit and Threads. ASTM A307 or ASTM F593 Stainless Steel.		
	Washers	Grey Iron, ASTM A126		
	Meter Bushing	1" x 1 1/4" Thread Size		
	Steel Pedestal	Steel Pedestal Pipe Support Under Each Meter or as Directed by Inspector		
	Valve Stem Extension	Steel, Welded Construction, Red Primer with Top Centering Ring and 2" Operating Nut or Approved Equal.		
	Valve Slip Can	Steel Slip Can Fit Cover, Class 35 Heavy Duty (Minimum of 90 lbs.)	C.I. – 562A vb or Approved Equal	Casting, Inc.
	Valve Can Tube	5" Cast Iron or Approved Equal		
	Valve Cover	8" Outside Diameter, Cast Iron		
	Tapping Saddle	1" Tap if Meter is New Bronze Double Strap Direct Tap into D.I. As Approved	Ford Or Approved Equal	
	Poly-wrap	Buried Mechanical Ductile Iron Joints, Grease and 8 mil Vinyl Wrap Plastic Cover		
	Bond Breaker	8 mil Poly Wrap for Concrete to Fitting Separation		
COMBINATION AIR / VACUUM VALVES				
	Air / Vacuum Valve	1" – 4" Single Body	APCO Val-matic	140C 201C & 203C
	Air / Vacuum	1" – 4" Dual Body	APCO Val-matic Crispin	1800 Series 101S/22 & 104S/38
TAPPING SLEEVES AND SADDLES				
	3" to 24" Tapping Sleeve	Stainless Steel		
	3/4" to 2" Service Saddle	Bronze/Brass w/ Double Strap		

2.2 Water Pipe Materials

This section covers water transmission pipe and fittings for the pressurized transmission and distribution of potable water for municipal service.

A. PVC

1. Polyvinyl Chloride (PVC) Pipe shall meet or exceed the requirements of AWWA C900 or AWWA C909. The pipe shall be homogeneous throughout, and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be uniform as commercially practicable in color, opacity, density and other physical properties. Pipe surfaces shall be free from nicks, scratches, gouges and other imperfection that might weaken the pipe wall or cause leakage at joints. The PVC pipe shall bear the seal of approval of the National Sanitation Foundation for potable water service.
2. Pressure class rated pipe shall provide not less than the following allowable working pressures as determined by AWWA C900 or AWWA C909:

<u>Allowable Working Pressure Class</u>	<u>Pressure psi</u>	<u>Minimum Dimension Ratio (DR)</u>
235	150	18
305	200	14

3. The dimensions and tolerances of the pipe barrel and bell ends shall conform to the applicable requirements of AWWA C900 or AWWA C909 for the pressure-class specified for cast iron outside diameter pipe.
4. All fittings and accessories shall be manufactured or recommended by the pipe manufacturer, or approved equal, and have bell and spigot configurations identical to that of the pipe. The pipe fittings may be manufactured from PVC, ductile iron or welded steel, and shall have strength equal to or greater than the pipe to which they attach. Fittings shall be installed as specified by the manufacturer.
5. The pipe and fittings shall be furnished with integrally thickened bell and spigot ends; for joining with a solid, uniform cross-sectional elastomeric gasket as the sealing element. Couplings are not permitted. The gasket shall be contained within the bell end. The gasket shall not be required to support the weight of the pipe when two sections are joined; but shall serve only as a seal and shall conform to ASTM D3139. The critical sealing dimensions of the bell, spigot, and gasket shall be in accordance with the manufacturer’s standard dimensions and tolerances. The gasket shall provide an adequate compressive force against the sealing surfaces of the bell and spigot so as to affect a positive seal under all combinations of the joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. Solvent welded joints are not permitted unless written approval is obtained from the District Engineer prior to welding the joint.
6. Special Requirements.
 - a. Marking on the pipe shall include the nominal cast iron pipe size, AWWA C900 or AWWA C909 Class and dimension ratio (DR), the NSF seal of approval, and the manufacturer’s name or trademark. Marking interval shall be not more than 5 feet.
 - b. PVC pipe is permitted for 10” and smaller pipe sizes; 12” and larger pipe shall be ductile iron, unless specifically approved by the District Engineer.
 - c. A tracer wire must be included to facilitate location of the pipe after burial.

B. Ductile Iron

1. 12” and larger pipe shall be ductile iron, unless specifically approved by the District Engineer.
2. Pipe shall conform to all requirements of the latest revision of AWWA C151/A 21.51. The minimum thickness for Ductile Iron Pipe shall be Pressure Class 250, unless otherwise shown on the approved plans.
3. Joints
 - a. Mechanical Joints. All mechanical joints shall meet the requirements of AWWA C110/A21.10 and AWWA C111/A21.11. All gasket surfaces shall be smooth, except for specified masking, and free from imperfections. Gaskets shall conform to tests in accordance with specifications and shall not be over one year old. Bolts shall meet all requirements of the above specification, honoring all characteristics, tolerances and tests.
 - b. Push-on Joints. All push-on joints shall meet the requirements of AWWA C111/A21.11. Gaskets shall be free from defects and not over one year old. Lubricants shall be non-toxic and have no deteriorating effects on gasket material. It shall not impart taste to water in a pipe. Lubricants shall conform in every way to AWWA C111/A21.11.
 - c. Flanged Joints. Flanged joints shall be bolted firmly with machine, stub or cap bolts of proper size. Flanges shall be cast integrally with the pipe; or shall be screwed on for threaded pipe. Flanges shall be faced and drilled and of proper dimensions for size and pressure required. All flanges shall meet the requirements of AWWA C110/A21.10. Unless otherwise specified, bolts and nuts shall be made of the best quality steel and have clean, well-fitting threads. Bolts shall be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the diameter required for each flange; and shall be of a length so that when installed, no more than 3/8-inch or less than 1/8-inch extends past face to nut. A gasket of proper size shall be installed for each flanged joint: ring type or full face as shown in the drawings.
 - d. Compression Joints. Compression joints shall be mechanical joint sleeve, Smith-Blair 441; or flange adapter, Smith-Blair Type 900; or approved equal.
4. Linings and Coatings. All ductile iron pipes shall have cement mortar lining and conform to AWWA C104/A21.4. All ductile iron pipes shall be coated with coal tar pitch varnish.
5. Fittings.
 - a. Mechanical Joint Fittings. Mechanical joint fittings shall conform to AWWA C110/A21.10 and shall be coated with coal tar pitch varnish.
 - b. Push-on Fittings. Push-on fittings shall conform to AWWA C111/A21.11 and shall be coated with coal tar pitch varnish.
 - c. Flanged Fittings. Flanged fittings shall conform to AWWA C110/A21.10 and shall be coated with coal tar pitch varnish.

6. Polyethylene Encasement

- a. All ductile iron pipe and fittings shall follow ANSI/AWWA C105/A21.5-05 Standards to provide corrosion protection for all pipe and fittings.
- b. The minimum thickness for high-density cross-laminated polyethylene film shall be 4 mil or 100um with tensile strength of 6,300 psi. The minimum tube and sheet sizes are listed in AWWA table 1.
- c. Install polyethylene tube with Method A, with minimum 12” overlap from joint where bags are approximately 2 feet longer than the pipe and circumferential wraps of tape should be placed at 2 feet intervals. Bends, reducers, offsets and other pipe shaped appurtenances shall be covered with polyethylene in the same manner as pipe.
- d. For installation below the water table, tube-form polyethylene should be used with both ends thoroughly sealed with adhesive tape.
- e. Junctions between wrapped and unwrapped pipe extend polyethylene to cover the adjacent pipe for a minimum of 3 feet. Secure end with circumferential turns of adhesive tape.
- f. Use same backfill materials as specified for pipe and exercise care to prevent damage to the wrapping when placing backfill.
- g. Openings such as branches, service taps, blowoffs, air valves and similar appurtenances by cutting an “X” in the polyethylene and temporarily folding back the film. After the appurtenance has been installed, tape the slack securely to the appurtenant. For direct service taps, apply two to three wraps of adhesive tape completely around the encased pipe to cover the area where the tapping machine and chain will be mounted.

C. HDPE

High Density Polyethylene Pipe (HDPE) shall not be permitted without written approval of the District Engineer. Developers proposing such pipe shall be required to provide a specification for review and approval by the District Engineer. If approved, a tracer wire must be included to facilitate location after burial.

D. Copper

1. Pipe. Copper pipe and tubing shall conform to ASTM B88. Copper pipe for direct burial or concrete encasement shall be Type “K” soft copper. Copper pipe for other exposure shall be Type “L” hard drawn copper.
2. Fittings. Fittings for pipe ½-inch and larger shall be pure wrought copper (no bronze or brass) of the solder-joint type. The fittings shall have a thickness of not less than the thickness of the pipe. The use of flare-type joints and compression couplings is also acceptable. Solder for use on solder-joint fittings shall be Sil-fos or equal soldering alloy. Lead-tin solder shall not be used under any circumstances. Joints shall be made strictly in accordance with the manufacturer’s instructions.

E. Polyethylene. Polyethylene pipe shall conform to ANSI/AWWA C904-06 Cross-Linked Polyethylene (PEX) Pressure Pipe ½ inch through 3 inches for Water Service. Pipe shall be CTS Copper Type Size OD SDR-9 Poly Tubing. See Typical Service Tap Detail CW6. Pipe shall have tracer wire included to facilitate location after burial.

2.3 Hydrants

General. Fire hydrants shall be provided with auxiliary gate valves and cast-iron valve boxes as indicated on the drawings and specified herein. Hydrants shall conform to requirements of AWWA C502, as supplemented and modified herein.

- A. Hydrants shall be manufactured by Mueller or approved equal.
- B. Hydrants shall have a 5-inch size main valve opening.
- C. Hydrants shall be designed for 200 psi minimum working pressure. Hydrants shall be constructed in three sections with bolted joints; and the entire internal operating mechanism shall be repairable from above ground without any digging, when the hydrant is in place.
 - 1. Hydrants shall have two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper nozzle. Nozzle threads shall be National Standard.
 - 2. Inlet connections shall be mechanical joints or flanged, conforming to AWWA C110.
 - 3. The hydrant shall have a breakable flange, at ground level when installed.
 - 4. Opening Rotation. Operating nut shall turn counterclockwise (left) to open the main valve.
 - 5. Drain Valve. The drain valve shall be threaded, NPT.
- D. Buried portions of the hydrant shall be painted with two coats of coal tar enamel. Exposed portions shall be painted with a primer coat and a finish coat which shall be vermilion red.
- E. An auxiliary gate valve and cast-iron valve box shall be supplied. The valve shall be the same size as the hydrant inlet connection, and the valve and valve box shall conform to requirements for valves, Section 2.7.
- F. Concrete for thrust blocks and collars shall be as specified in Section 5.1 CONCRETE

2.4 Water Service Connections

- A. Service connections shall be made by means of a service saddle, brass double strapping tapping saddle Ford 202B series or approved equal on PVC mains. Direct taps may be used with approval of the District Engineer.
- B. The corporation stop shall be a Ford 700B or approved equal, of the same size as the diameter of the water service lateral.
- C. The yoke or setter shall be Ford 70 Series full 3/4" VBHC 72-21W-11-33NL or approved equal. Model may be adjusted as required for meter size.

2.5 Meter Boxes

- A. Meter boxes for 3/4-inch meters shall be 18" diameter 30-inches deep with ADS Plastic Meter Pit or approved equal in park strips, or precast concrete meter box if located in traffic areas and provide DL Model L-2241 Meter Box Lid and Rim with 2" Hole for radio read.
- B. Meter boxes for 1" meters shall be 21" diameter 30-inches deep with ADS Plastic Meter Pit or approved equal, or precast concrete meter box if located in traffic areas and provide DL Model L-2241 Meter Box Lid and Rim with 2" Hole for radio read.

2.6 Valve Boxes

- A. All valves to be buried shall have cast iron valve boxes, firmly supported and maintained, centered and plumb over the wrench nut of the valve. The boxes shall be of the extension type with 39- to 60-inch extension. Boxes shall be equal to those manufactured by Tyler Pipe Industries #664-S or approved equal. Lids shall have the designation "Water" cast into them.

2.7 Gate Valves

- A. General. 4-12 Inch Gate Valves shall be bronze-mounted, double-disc, iron body gate valves, and, when so indicated or specified, shall have enclosed spur or bevel gearing. Valves shall have a minimum working pressure rating of 200 psi. Valves shall be non-rising stem, unless rising stems are indicated on the drawings. Valves shall meet the requirements of AWWA Specification C-500, except as modified herein. Valves shall operate drip tight with full pressure on either side of the valve and no pressure on the other side. Packing and gearing shall be replaceable while the valve is in service. End connections shall be flanged, push-on joint, mechanical joint, or slip joint.
- B. The flanges and drilling shall conform to dimensions of ANSI Standards for Class 125 or Class 250, for cold water. The joints shall be manufactured to conform to requirements of AWWA C110/A21.10.
- C. Valves shall be so designed that the gates and stem are clear of the full specified diameter when open.
- D. All valves shall turn clockwise to close.
- E. When so indicated or specified, valves shall have cut steel spur gears or bevel gears in a factory-installed, enclosed gear case. The case shall be air, water, and oil tight with seals on all shafts. A worm gear position indicator shall be provided with geared valves.
- F. The operating nut or wrench nut shall be cast iron and shall be carefully fitted to the top of the valve stem, secured to the stem by a threaded nut; with threads ½-inch minimum, National Coarse. The operating nut shall be 1-15/16-inch square at the top, 2-inch square at the base, and at least 1-3/4-inch high. There shall be a round flange at the base with a distinct arrow cast on the nut, and lettering to indicate direction to close or open.
- G. The stems for all valves shall be of corrosion resistant material.

2.8 Butterfly Valves

- A. General. Butterfly Valves shall be cast iron body, bronze mounted. Use butterfly valves on 14” and larger water mains. Valves shall conform to the requirements of AWWA C504, except as modified herein. Short body or long body at contractor’s option or short body only where disc will not interfere with adjacent fittings. Valves shall operate drip tight with full pressure on either side of the valve and no pressure on the other side. Packing and gearing shall be maintenance free. End connections shall be flanged or mechanical joint.
- B. The flanges and drilling shall conform to dimensions of ANSI Standards for Class 125 or Class 250, for cold water. The joints shall be manufactured to conform to requirements of AWWA C110/A21.10.
- C. Valves shall be so designed that the gates and stem are clear of the full specified diameter when open.
- D. All valves shall turn clockwise to close.
- E. When so indicated or specified, valves shall have cut steel spur gears or bevel gears in a factory-installed, enclosed gear case. The case shall be air, water, and oil tight with seals on all shafts. A worm gear position indicator shall be provided with geared valves.
- F. The operating nut or wrench nut shall be cast iron and shall be carefully fitted to the top of the valve stem, secured to the stem by a threaded nut; with threads' ½-inch minimum, National Coarse. The operating nut shall be 1-15/16-inch square at the top, 2-inch square at the base, and at least 1-3/4-inch high. There shall be a round flange at the base with a distinct arrow cast on the nut, and lettering to indicate direction to close or open.
- G. The stems for all valves shall be of corrosion resistant material.

2.9 Fittings

- A. All pipe fittings shall be suitable to the pipe to which they are connected and shall be installed in accordance with the manufacturer's recommendations.

2.10 Bedding

- A. All water piping shall be bedded in sand free of loam and organic matter with District approved gradation.
 - Sieve 3/8 passing 100% by weight (recommended)
 - Sieve 100 passing 1-10% by weight (recommended)

2.11 Vaults

- A. Vaults shall be constructed of concrete, pre-cast. They shall be installed according to the minimum dimensions shown on and otherwise in conformance with the approved plans.

2.12 Water Installation

The construction requirements for culinary water systems will apply to Secondary Water Systems unless otherwise noted.

A. Excavation and backfill.

1. Earthwork for pipe trenches shall include trench excavation, providing and placing bedding, borrow for backfill and bedding, backfill within the pipe zone, backfill above pipe zone, shoring, compaction of material, and consolidation of material.
2. Standards. All applicable standards and rules applying to pipe excavation and installation shall be strictly adhered to, including, but not limited to, the following:
 - a. AWWA C605.
 - b. AWWA C600.
 - c. Specifications for excavation on State Highways, latest revision.
 - d. General Safety Order Covering Utah Industries - Section 69, trenches.
 - e. United State Department of Labor OSHA Publication 2085 - "Employer - Employee, Safe Practice for Excavation and Trenching Operation".
 - f. Utah Occupational Safety and Health Rules and Regulations - General Standard (UOSHA).
 - g. AASHTO T-180.

B. Excavation.

1. Excavation shall be accomplished to allow the pipe to be laid to the line and grade shown on the drawings or as directed by the District Engineer.
2. The Contractor, at his option, may leave all or part of the trench unshored or unbraced. If this is the case, the sides of the trench shall be sloped to meet safety standards. Trenches less than four feet deep may be constructed with vertical walls. Trenches not meeting UOSHA standards will not be entered by the District Inspector, and pipes will not be inspected or accepted.
3. The District Inspector may require that unsuitable materials located beneath the pipe zone be over-excavated, backfilled and compacted to 95% maximum density as defined in AASHTO T-180.

C. Laying Pipe

1. Pipe shall be bedded in sand, as specified in these Standard Specifications free of loam and organic matter for a minimum of 6" below the pipe and 12" above the pipe. Gravel bedding or the use of other bedding materials is not permitted. Tees, elbows, crosses, and reducers shall be used for changes in direction and outlets. Where cap screws or stud bolts are needed, flanges shall be tapped to support cap screws or stud bolts. Anchors and thrust blocks shall be placed at valves, elbows, tees, etc. as shown on approved plans and standard details. All flanges shall be faced and drilled.
2. Valves which are not located in a dedicated right-of-way shall have a sign posted near the valve so that it may be easily located. The sign will be provided by KID; the Developer is responsible for providing a metal post, and placing it near the valve, so that the sign will be approximately 4 feet above grade.
3. All below grade bolted joints shall be coated with Poly FM (food grade) grease and wrapped in 8-mil black plastic. The plastic shall be held in place by 2-inch-wide plastic backed adhesive tape, Polyken No. 900, Scotchrap No. 50, or approved equal.
4. A 12-gage tracer wire shall be laid with PVC pipe, terminating at accessible locations in the valve boxes.
5. A warning tape marked "Buried Water Line", 3M EMS or similar, shall be placed directly above the water line approximately 12 inches above the top of pipe.

- D. Compaction. Trenches over waterlines shall be backfilled and compacted in accordance with requirements of the City or County having jurisdiction.
- E. Alignment. Waterlines shall be placed in accordance with the approved plans. Curved alignments are permitted within tolerances of the pipe manufacturer, and as shown on the plans. Deviations from the approved plans are permitted only with approval by the District Engineer. Such deviations shall be shown on the AS-BUILT Drawings. The Contractor is responsible for verifying the maximum degree of curvature allowed according to the AWWA standards and the manufacturer's recommendations for the type and size of pipe being installed. Where field conditions require deflection for curves not anticipated by the approved plans, methods to be used shall be presented to the District Engineer for approval.
- F. Tapping. The cast iron tapping sleeve and cast-iron tapping valve shall be of the sizes indicated, and designed for 200 psi working pressure, intended to permit tapping the existing waterline with pressure in the line. Tapping sleeve and tapping valve shall be products of the same manufacturer and shall comply with MSS SP-11.
 - 1. Tapping Sleeve. The tapping sleeve shall be a mechanical joint type with Class 125 cast iron outlet flange. End gaskets shall be duck-tipped type. Provide H615 tapping sleeve as manufactured by Mueller Co. or approved equal.
 - 2. Tapping Valve. The tapping valve shall have mechanical joint inlet with Class 125 cast iron flange. Outlet shall be slip-on joint end. Tapping valve shall be Model H667 as manufactured by Mueller Co. or accepted equal.
 - 3. Valve Box. Cast iron valve box shall be extension type, Tyler Pipe Industries #664-S with 39- to 60-inch extension or accepted equal. Install centered and plumb over the wrench nut of the valve.
- G. Water Service Connections
 - 1. Furnish and lay, or install by jetting, type "K" copper tubing as specified under "Copper Tubing" with a diameter equal to the size of the service connection. Where the service lateral is longer than 50 feet from main to meter, the diameter shall be one size larger than the meter. Fittings may be flair or compression type. Tubing shall extend from corporation stop to the meter yoke or meter valve and from meter yoke or meter valve to a point fifteen feet beyond the property line. Tubing shall be capped and marked with a 2x4. An expansion loop shall be formed in the soft copper tubing in a horizontal plane at the connection to the corporation stop. See detail on drawings.
 - 2. The water service line shall be bedded in sand bedding the entire length of service line. No joints or connections are permitted between the corporation stop and the yoke or setter.
 - 3. The meter box shall be installed in the park strip between the back of the curb and sidewalk and shall not be located in driveways or drive approaches. See also Section 1.2.1.2. Variances from these requirements shall be permitted only by approval of the District Engineer. If relocation of a meter box to avoid interference with a driveway or drive approach is required, an application for a Sub-Standard Agreement shall be completed, and applicable fees shall be paid to the district, submitted to the district and approved by the District Engineer.
 - 4. Service connections shall be installed, as above described, as soon as possible after installation, testing and flushing of the water main. Service connections shall not be made closer than 2 feet to one another, or to a joint or valve.
 - 5. Across State Highway rights-of-way, service lines shall be installed by auguring, open cut trench, or other method that may be approved by the Utah Department of Transportation. In other than State Highway rights-of-way, service lines shall be laid in an open cut trench; except that pipe 2-inches or smaller may be jetted under existing improved surfaces.
 - 6. Inspection. Before backfilling, contact the District Inspector for inspection and approval of service connection.

H. Frost protection

1. Water lines shall be placed at a depth that will provide at least 48 inches to the finished ground surface. Excavations, while open, shall be protected from frost to assure that pipes are not placed in or on frozen ground.

I. Flushing and testing. See Section 2.15 A. Water Quality Tests

J. Waterline loops

1. Where it is necessary to provide a loop for a waterline to prevent interference with an existing storm drain or other utility, such loop shall be of shop welded steel pipe, with mechanical joints or flanged fittings at each end. No non-welded joints are permitted in the loop.

K. Hydrants

1. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting. Hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb.
2. Hydrants shall be set to final finish grade, with nozzles at least 18-inches above the ground. A concrete pad shall be provided at all fire hydrants as shown on standard details. Bolts at breakaway flanges shall be fully accessible.
3. Concrete thrust blocks shall be provided for the hydrant bowl, auxiliary gate valve, and elsewhere as indicated on the drawings.
4. Below grade bolted joints shall be coated with food grade grease and wrapped in 8-mil black plastic. The plastic shall be held in place by 2-inch-wide plastic backed adhesive tape, Polyken No. 900, Scotchrap No. 50, or approved equal. To provide for drainage of the hydrant, a short pipe nipple shall be extended through the plastic to drain the water to the gravel outside the film wrap.
5. The hydrant, valve and connecting piping shall be flushed, tested and disinfected. The hydrant shall be flushed with all outlet valves open.
6. The Contractor shall use only hydrant wrenches to open hydrants. He shall also make certain that the hydrant valve is open "full", since "cracking" the valve causes damage to the valve and promotes washout under the hydrant due to leakage at the drain port. An approved auxiliary valve shall be provided on the outlet line for control purposes. Fire hydrant valves must be closed slowly and completely to avoid a surge on the system which creates undue pressure on the water lines. The Contractor shall carefully note the importance of following these directions.
7. If one of the Contractor's employees shall knowingly or unknowingly damage any hydrant valve system, the Contractor shall be responsible for all resulting costs and damages. He shall immediately notify KID so that the damage can be repaired as quickly as possible.
8. Upon completing the use of the hydrants, the Contractor shall notify KID, so that the hydrants may then be inspected for possible damage. Any damage resulting from the use of the hydrants by the Contractor will be repaired, if necessary, by KID and the cost thereof shall be borne by the Contractor.
9. The Contractor shall furnish all connectors, wrenches, valves, and small tools that may be necessary to meet the requirements of KID pertaining to hydrant use.

2.13 Casing Pipe

- A. If a crossing of a structure (canal, rail, creek, etc.) is greater than 15 feet, the water line crossing shall have isolation valves on each side of the crossing and the pipe shall have restrained joints.
- B. Casing pipe shall be used to protect the carrier pipe at railroad crossing, canal crossings, and highway crossings where shown on the drawings or where directed by the District Engineer. Casing pipe and installation shall meet the requirements of the railroad, highway department, or other utility being crossed, as well as these Specifications. Alignment and grade of the casing pipe

shall be maintained so that the carrier pipe can be installed to the line and grade as shown on the drawings.

- C. Steel casing pipe shall be welded steel pipe meeting the requirements of ASTM A53 and shall be provided with cathodic protection.
- D. Size and Wall Thickness. Steel casing pipe shall be as per the minimum specified requirements within these Design Standards.
- E. Casing shall be installed by jacking, tunneling, auguring, or other method that may be approved by the owner of the railroad, canal, or highway, and the District Engineer. The hole for the casing shall be same size as the outside of the casing. Over-break shall be filled with sand or grout pumped into the opening after setting the casing. The casing shall be watertight. The carrier pipe shall be placed to line and grade on a bed of sand, and the void space between casing and carrier shall contain approved spacers.
- F. Responsibility for Work. All of the operations of the Contractor in constructing the portions of the work under railroad tracks, canal, or highway shall be subject to the approval of the railroad, canal, or highway owner. The Contractor shall enter any agreements with and shall furnish any and all indemnity and other Bonds that may be required by them for the protection of the railroad, canal, or highway owner against injury and interference with traffic and service by operations of the Contractor. The Contractor shall provide services of guard, flag person, etc., as required by the authority having jurisdiction. The Contractor shall secure permission from the affected utility before commencing on the portion of the work within the right-of-way and under the tracks, canal, highway or other improvements. The Contractor shall be solely responsible for the safety and adequacy of his construction plans and methods and for any damage which may result from their failure.

2.14 District Inspections

- A. The District Inspector shall act as a District representative during the construction period.
- B. The District Inspector shall decide questions that may arise as to quality and acceptability of materials furnished and Work performed.
- C. The District Inspector shall interpret the intent of these Design Standards and Construction Specifications in a fair and unbiased manner.
- D. The District Inspector will make visits to the site and determine if the Work is proceeding in accordance with the Design Standards and Construction Specifications. The Inspector shall at all times have access to the Work. The Contractor shall provide proper facilities for such access and observation of the Work and also for any inspection or testing thereof.
- E. If any Work is covered contrary to the instructions in these Specifications, it must, if requested by the District Inspector, be uncovered for his observation and if rejected be replaced at the Contractor's expense.
- F. If the District Engineer considers it necessary or advisable that covered Work be inspected or tested, the Contractor, at the District Engineer's request, shall uncover, expose or otherwise make available for observation, inspection and/or testing as the District Engineer may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor shall bear all of the expenses of such uncovering, exposure, observation, inspection, and testing and satisfactory reconstruction.
- G. No Work shall proceed unless the Contractor has informed the District Inspector of such Work. While continuous inspection by the District Inspector is not required, daily inspection may be expected. If daily inspection does not occur, the Contractor should so notify the District Engineer.

- H. The Contractor will be held strictly to the requirements of the Design Standards and Construction Specifications in regard to the quality of materials, workmanship and execution of the Work.
- I. Inspections may be made at the factory or fabrication plant or the source of material supply.
- J. The District Inspector will not be responsible for construction means, controls, techniques, sequences, procedures, or safety.
- K. The District Inspector shall promptly make decisions relative to the interpretation of the Design Standards and Construction Specifications.
- L. The decisions, actions, or inactions of the District Inspector shall not relieve the Contractor of any of the Contractor's responsibilities.
- M. The District Inspector shall have the right to reject any Work which does not conform to these Design Standards and Construction Specifications. Such Work shall promptly be removed, replaced and retested at no cost to the district.
- N. The District Inspector shall have the right to determine when and where all testing shall be performed.
- O. All required tests of compaction, concrete, or other materials or processes shall be performed by agencies qualified to perform such work. Evidence of such a qualification may be required by the District Inspector. The results of these tests shall be provided to the District Inspector at no expense to KID.
 - 1. Compaction tests shall be performed by qualified, independent soils testing firms in accordance with standards established by the prevailing authority for roads. Where compaction of soil under or around pipes is required due to over-excavation, testing shall be to not less than 95% in accordance with AASHTO T-180.

2.15 Water System Inspections

A. Water Quality Tests- Follow Current AWWA Standards C651-14

1. **Disinfection.** The Contractor shall be responsible for maintaining the disinfected condition of existing water lines when connecting to, cutting into, repairing or tapping existing water lines. Disinfection procedures for these operations shall be in accordance with the AWWA Standard C651-99. Mains shall be flushed unless approved by the District Engineer. Taps required by the Contractor for chlorination or flushing purposes shall be provided by him as part of the construction of water mains.
2. **Disposal of Treated Water.** The Contractor shall be responsible for disposal of heavily chlorinated treated water flushed from mains and shall neutralize the wastewater for protection of the environment before disposal into any natural drainage channel, sanitary sewer, storm drain, curb and gutter or onto the ground. The Contractor shall be responsible to confirm the acceptable point of discharge with the District Engineer prior to chlorination of the waterline.
3. **Bacteriological Samples.** Twenty four (24) hours after the line is flushed the Inspector will take samples from the installed pipe line. The locations of the samples shall be at intervals along the pipeline as selected by the Inspector. The sampling bottles and methods used will be in accordance with the Utah State Board of Health “Public Drinking Water Regulations”, or other similar applicable regulating agencies.
4. **Records and Documentation.** All disinfection operations shall be observed by, and will be recorded by, the District Inspector. The Contractor shall provide to the District Inspector information regarding the length of pipe disinfected, size of pipe, type of pipe, location of pipe, date, time and duration of disinfecting operations, complete list of equipment used and personnel performing the disinfection, and any comments about the disinfection operations.
5. **Repetition of Flushing and Testing.** Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained.

B. Pressure tests

1. All pipe and fittings or other items to hold or convey liquids shall be tested for leakage in the presence of the District Inspector. Testing for leakage shall be done after the pipe has been cleaned and tested for alignment when applicable, before disinfection when applicable, and before painting or embedding in concrete when applicable. Prior to testing for leakage, underground pipelines shall be backfilled to a level acceptable to the District Inspector, and the backfill in place shall have been compacted or consolidated to Project density requirements.
2. All valves, joints, seams, couplings, fittings, flanges, welds, etc., in pipelines shall be watertight.
3. Leakage is defined as the release of any water, air or smoke passing through the pipes, including joints, fittings, outlets, etc. Measurement shall be made by direct measurement of the amount of water, air or pressure lost or by the amount required to be added to maintain the original level of pressure. Drops of water or evidence of smoke or bubbles will be considered as evidence of leakage.
4. Valves, hydrants, gates, fittings, and special fittings shall be tested for water tightness. Each valve and hydrant shall be closed so that reaches of pipe between valves can be tested. Reaches being tested shall have approved taps placed in high points, to release trapped air and to be used as access points for filling and testing. Lines shall be filled with

water of similar quality to the water the line will carry. Pressure shall be raised to not less than 200 psi (except 150 psi maximum against butterfly valves) and continuously maintained for two (2) hours. During this test period, no loss of pressure shall occur. If make-up water is required to maintain pressure, the cause for the leak shall be identified and corrected and the line shall be retested until there is no leakage or loss of pressure.

5. Records and Documentation. The pressure tests shall be recorded by the Contractor with the District Inspector present. Records shall contain the length of pipe tested, size of pipe, type of pipe, rated working pressure of pipe, time and duration of test(s), pressure(s) used, complete list of test equipment used, list of personnel performing the test(s), and any comments about the test. Test records shall be submitted to the District Inspector before the water line is accepted. A “Contractor’s Materials and Test Certificate for Underground Piping” shall be completed and submitted to the District Inspector.

3.0 Sewer Specifications

3.1 Sewer Systems Material Summary Table

3.1 Sewer System Material Summary Table

	ITEM	DESCRIPTION	MANUFACTURER	MODEL
3.2 SEWER PIPE				
	4" to 24" PVC	PVC SDR 35 – ASTM F679 & ASTM D3034 Bell & Spigot with Rubber Gasket	JM Eagle, Vinyl Tech, North American Pipe	
	24" to 60" PVC	Glass-Fiber Reinforced Polymer (GFRP) Pipe	HOBAS Pipe	
	Nose-on Lateral Connection to Main Line Sewer	"Inserts Tee" or Equal		
	Sewer Pipe Connectors	Fernco Or Approved Equal		
3.3 MANHOLES				
	8" Entry Pipe 48", 60", 72" Dia.	Precast Concrete Sections Conforming to ASTM C478 (See Std. Dwg. SS2)	Dura-Crete Old Castle Amcor	
	10" – 24" Entry Pipe 48", 60", 72" Dia.	Precast Concrete Sections with Con Shield Additive or Polymer Manhole System	Dura-Crete Old Castle Amcor Armorock	
	Force Main Discharge Manhole 72" Diameter	Precast Concrete Sections with Con Shield Additive or Polymer Manhole System	Dura-Crete Old Castle Amcor Armorock	
	Joint seal for Concrete Manholes & Grease Interceptors	Kent Seal Preformed Plastic Gaskets – Federal Specification SS-S-210(A) – RUB'R-NEK L-T-M	K.T. Snyder Co., Houston, Texas or Approved Equal	
	Ring & Cover	D&L Foundry A1180 or Equal 22-3/4" Diameter Clear Opening, Solid, Non-Rocking, Heavy Duty Type with "Kearns Improvement District		
	Manhole Steps	Cast-in-Place Copolymer Polypropylene-encased, 60,000 psi Tensile Strength Steel,	M.A. Industries, Inc., or Approved Equal	Model PS1-PF
	Drop Manhole	NOT PERMITTED without Specific Approval of District Engineer		
3.4 GREASE INTERCEPTOR				
	Grease Interceptor	Precast Concrete – Minimum 1000 gallon. See Standard Drawings for Sizing Requirements & Details	Dura-Crete Old Castle Amcor	

3.5 SEWER METERING				
	Support	Supports, mounting posts, poles and rails as required.		
	Prefabricated Manhole with Integral Flume	Parshall Flume & Metering Manhole	Virtual Polymer Compounds, LLC	
	Controller	Siemens (Milltronics) OCM III mounted indicator transmitter, housed in a NEMA 4X enclosure complete with one weather-proof power outlet, located on a pole next to the metering manhole.	Siemens	
	Temperature Sensor	Siemens TS-2 Temperature Sensor	Siemens	
	Flow and depth sensor	Echomax XRS-5 Ultrasonic continuous level measurement transducer	Siemens	
	Open Channel Flow Meter and Depth Sensor	The flow meter including depth sensor and flow transmitter shall be ultrasonic type. The system electronics for the flow transmitter shall measure and convert the time lapse between transmitted and received ultrasonic signal at the sensor into a usable current signal. The electronics shall also compensate the liquid level signal for the time delay variation caused by temperature changes and then characterize the resultant signal by the “flow-to-head” curve for the respective flow element being monitored to yield a 4-20mA _{dc} output signal that shall be linearly proportional to flow. The 4 mA _{dc} value of the output signal shall correspond to zero head and a zero flow, while the 20 mA _{dc} value of the output signal shall correspond to maximum head and maximum flow for the open channel flow metering equipment being installed		
	Fiberglass Grating	Square Duragrate Molded Fiberglass Grating		
	GE PLC	GE Versamax PLC with CPU E-05 Power Supply PWR202 and Analog Input Card AL G262		
	Communication Equipment – Radio	GE MDS INET 900 IP radio with PCTEL Maxrad 710-970 MHZ Yagi Antenna and all required connectors and cabling.		
	Cabling	½” Heliac Times Microwave LMR-600 or equal		
	Lightening Protector	PolyPhaser IS-50NX-C2-MA bulkhead mounted		
	Grounding Kit	Wireless Solutions WGK-U2H5-UT or equal		
3.6 SEWER LIFT STATION				
	Lift Station Site	All Hard Surface, Concrete Access – Minimum 30’x 30’ Parcel Conveyed to KID	No Public Lift Stations allowed except approved by District Engineer	

Sewer Lift Station Wet Well- Size Approved by District Engineer	Reinforced Concrete Cast in Place with Baffle and constructed with Conshield		
Submersible Non-Clog Wastewater Pumps	Flygt Pump (Spare pump provided to KID with each installation)		
Force Main Pipe	HDPE SDR-11 with Cleanouts		
Discharge Piping	Ductile Iron Pipe CL-50		
Piping Flange	Ductile Iron CL-125		
Level Sensor	Multitrode level control system with backup float by Flygt		
Electrical Conduit	PVC Schedule 40		
Anchor Bolts	Stainless Steel, American Standard Machined Heavy Hexagon Heads with Class 2 Fit and Threads. ASTM A307 or ASTM F593 Stainless Steel.		
Access Hatch	Safe Hatch by Flygt		
Automatic Flush Valve	Flygt		
Check Valves	Ball Valves		
Electrical Supplies & Components	Comply with National Electrical Code requirements for Class 1, Group D, Division 1. Enclosure to meet NEMA 4X with a stainless steel dead front enclosure and aluminum inner door		
Odor Control	Bio-Rem with bio-trickling filter tank and media		
Standby Generator	Diesel fueled manufactured by Cummins		
Site Plan	As approved by District Engineer		
Hydraulic Vertical Pivot Gate	Approved by District Engineer		

3.2 Sewer Pipe

This specification identifies pipe and fittings suitable for non-pressure drainage of wastewater.

A. PVC Sewer pipe

1. All PVC Pipe and fittings shall be suitable for use as gravity sewer conduit. Provisions shall be made for contraction and expansion at each joint with a rubber ring, and the pipe shall be constructed with integral-wall bell-and-spigot push-on type joints. All PVC gravity sewer pipe and fittings shall meet or exceed all of the requirements of ASTM D3034. Minimum wall thickness shall be SDR-35.
2. Fittings. All fittings and accessories shall be manufactured and furnished by the pipe supplier or approved equal and shall have bell and spigot configuration's compatible with that of the pipe. The fittings shall be manufactured of the same materials as the pipe to which they attach and shall be installed as specified by the pipe manufacturer.
3. Joints. The pipe and fittings shall be furnished with push-on type bell and spigot ends for joining with a solid, uniform cross-sectional rubber gasket as the sealing element. The rubber gasket shall meet the requirements of ASTM 3212. The bell shall consist of an integral wall section with the rubber gasket factory-assembled and securely locked to prevent displacement. The critical sealing dimensions of the bell, spigot and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The gasket shall provide an adequate compressive force against the sealing surfaces of the bell and spigot so as to affect a positive seal under all combinations of the joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. Solvent welded joints will not be allowed for pipe sizes greater than 6" unless written approval is obtained from the District Engineer prior to welding the joint.
4. Each pipe shall be clearly marked at 5-foot intervals to show the manufacturer's name or trademark, nominal pipe size, ASTM Designation, and have the material designation "PVC". All fittings shall be marked in a similar manner.

B. HDPE Sewer Pipe

1. HDPE sewer pipe shall be PE3408 striped high density polyethylene pipe manufactured in accordance with and conforming to all requirements of ASTM D-3350 and ASTM F-714, including ASTM standards for PE3408, Type III, Category 5, Class C, Grade P34. The minimum wall thickness to be SDR 17 for Sewer Main lines and SDR 11 for pressure Sewer Laterals. Exact wall thickness for force mains and pressure Sewer Laterals shall be determined based upon operating pressures. All HDPE sewer pipes shall be color coded according to the color striping codes developed by the Utility Location and Coordination Council of the American Public Works Association (APWA).

C. HDPE Joints

1. HDPE pipe is to be joined by butt fusion method conforming to ASTM D 2657 and manufacturer's recommendations; to provide heat weld as strong as pipe wall.

D. HOBUS Pipe or Glass-Fiber Reinforced Polymer (GFRP) Pipe

1. Pipe: Glass-Fiber Reinforced Polymer (GFRP) Pipe conforming to ASTM D 3262 and manufacturer's recommendations. Manufacture pipe by a casting or a continuous filament winding process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed

to sewer flow shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall provide UV protection to the exterior. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3 per ASTM D3262. Pipe and Fittings shall be free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe and fittings shall be as uniform as commercially practical in cold opacity, density, and other physical properties.

2. Joints: Pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole mean to maintain joint water tightness. The joints must meet the performance requirements of ASTM D4161. Joined at tie-ins, when needed, may utilize gasket-sealed closure couplings.
3. Stiffness: Each pipe shall have sufficient strength to exhibit the minimum pipe stiffness at 5% deflection as required by the Engineer. Stiffness shall be tested in accordance with the test method of ASTM D2412. One pipe shall be tested every 100 lengths of each type, grade, and size pipe produced.
4. Corrosion Resistance: Pipe shall meet or exceed the requirements of ASTM D3262 when tested in accordance with ASTM D3681.
5. Installation, Cleaning and Flushing, Inspection and Testing per manufacturers recommendations.

D. Electronic Marker

1. Omni Marker model 162 Electronic Marker as produced by Industrial Technology.

E. Geotextile Fabric

1. Non-biodegradable, non-woven, drainage fabric; Amoco No. 4547, Tyvar No. 3401, or approved equal.

F. Polymer Concrete Pipe

1. Polymer concrete pipe shall be manufactured in accordance with ASTM D6783. Resin shall be polyester or vinyl ester to suit intended use with no Portland cement. Joints shall meet the performance requirements of ASTM D6783 at 35 psi when tested in accordance with ASTM D4161. Stainless steel joint sleeves/couplings shall meet the requirements of ASTM A276 with ASTM F477 gaskets. Assembled joints shall be flush with outside diameter. US Composite Pipe South or approved equivalent.

G. Casing Pipe Materials

1. Welded Steel Pipe: ASTM A53, Grade B or approved equivalent.
2. Casing Insulators: Stainless steel casing insulators with 12-inch-wide band and 2-inch-wide glass reinforced plastic runners; Model S12G-2, manufactured by Pipeline Seal and Insulator, Inc. or approved equal.
3. Casing End Seals: Flexible S-shaped seals fabricated on synthetic rubber with stainless steel bands and clamps; Model S Pull-on End Seals, manufactured by Pipeline Seal and Insulator, Inc., or approved equal.
4. Casing End Seals: Flexible seals fabricated of synthetic rubber with stainless steel bands and clamps; Model C Pull-On End Seals, manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

The minimum wall thickness of casings shall be as follows:

Pipe Size	Min. ID Casing Size	Min. Wall Thickness
4"	12"	0.188"
6"	16"	0.312"
8"	18"	0.312"
12"	24"	0.438"
16" or 18"	30"	0.50"
24"	36"	0.625"
30"	42"	0.625"
Greater than 30"	Larger casings as directed by the District Engineer	

5. Bedding and Cover Materials
 - a. Pipe Bedding Material as specified.
 - b. Trench Backfill Material as specified.

3.3 Manholes

- A. Pre-cast Sections. Except as otherwise specified herein or indicated on the drawings, manholes shall be constructed using pre-cast base, riser, cone or flat slab top, and grade ring sections conforming to ASTM C478, Pre-cast Reinforced Manhole Sections.
- B. Concrete. Cast-in-place concrete, and grout, shall conform to applicable requirements of Section 5.1 Concrete.
- C. Base. Pre-cast base shall be manufactured by W.R. White Company, or Amcor, Inc., or approved equal. Clear inside dimensions shall be 48", 60" or 72" diameter, as indicated in the design drawings.
- D. Riser. Riser section(s), extending from the top of the base to the bottom of the cone section or flat slab top, shall be pre-cast sections. Clear inside dimensions shall be 48", 60" or 72" diameter, as indicated in the design drawings.
- E. Top Sections. Manhole tops shall be pre-cast sections, either eccentric cone sections or flat slab tops. The top opening shall be 30-inches minimum. Flat slab tops shall be used only where indicated in the drawings. Design shall be based on H-20 live load and one-foot maximum earth cover.
- F. Joints. Wall joints, except grade rings, shall have male and female ends so that when the riser(s) and top are assembled, the interior wall surface of the manhole shall be a uniform and continuous surface within the tolerance of ASTM C478. Joints between pre-cast sections, except grade rings, shall be sealed with preformed plastic gaskets conforming to Federal Specifications SS-S-210(A), or with approved bituminous mastic sealant. Plastic gaskets shall be RUB'R-NEK L-T-M as manufactured by K.T. Snyder Company of Houston, Texas, or approved equal.
- G. Grade Rings. Grade rings shall be precast, as required, to adjust height of manhole lid and frame. Grade rings shall use a mastic sealer to insure watertight installation. Maximum height is 12-inches.
- H. Frames and covers. Frames and covers shall have a 22-3/4-inch diameter clear opening; and shall be gravity, solid, non-rocking, heavy duty type meeting requirements for standard manhole rings and covers. Covers shall have pick holes for opening, lockable lid if indicated, vented lid design in improved areas and solid lid design in unimproved areas, H-20 highway load rating. Covers shall have 3/4" diameter vent holes. Castings shall be of uniform quality free of porosity, hard spots, and shrinkage defects. Covers shall have a low-profile waffle pattern similar to D&L Supply A 1181-WP and shall have "Sewer" and "Kearns Improvement District" cast into them.
- I. Manhole Steps. Provide plastic encased steel steps in walls, at spacing and orientation indicated on standard drawings, Manhole Details. Steps shall be cast in place and shall be co-polymer polypropylene-encased, 3/4-inch diameter minimum, 60,000 psi tensile strength steel, Model PS1-PF manhole steps as manufactured by M.A. Industries, Inc., or approved equal. Steps shall be installed at 12" on center vertically, set into manhole wall directly under opening.
- J. Collars. Collars shall be constructed of concrete as indicated on the drawings.
- K. In locations with pipes 12 inches in diameter or larger, and in locations where required by the District Engineer, concrete materials shall be cast with CONSHIELD admixture or approved equal.
- L. Drop Manholes. Drop manholes shall **not** be permitted without specific approval of the District Engineer.
- M. Laterals. Sewer laterals to customer properties shall be located at a depth and location so as to provide gravity service to any portion of the property.

3.31 Acid Resistant Polymer Manholes

- A. Provide acid resistant polymer manhole sections, base sections and related components conforming to ASTM C 478. ASTM C 478 material and manufacturing is allowed compositional and dimensional differences required by a polymer product.
- B. Provide base riser section with integral floors, unless shown otherwise.
- C. Provide riser sections joined with a flush flat end, alignment guides and gaskets so that on assembly, manhole base, riser and top section make a continuous and uniform manhole.
- D. Construct riser sections for polymer manholes from standard polymer manhole sections of the diameter indicated on drawings.
- E. Use various lengths of manhole sections in combination to provide correct height with the fewest joints.
- F. Design wall sections for depths and loading conditions with wall thickness (minimum 3 inches)
- G. Provide tops to support HL-93 vehicle loading and receiving cast iron frame covers, as indicated on drawings.

H. Design Criteria

Manhole risers, flat lids, grade rings and manhole base sections shall be designed by manufacturer, to meet the intent of ASTM C 478 with allowable compositional and sizing differences required by a polymer product.

- 1. AASHTO LRFD HL-93 design live loading applied to manhole cover and transition and base slabs.
- 2. Polymer manholes will be designed based upon live and dead load criteria in ASTM C 857
- 3. Unit soil weight of 120 PCF located above portions of manhole, including base slab projections.
- 4. Internal liquid pressure based on unit weight of 63 PCF.
- 5. Dead load of manhole sections fully supported by transition and base slabs.

I. Design

Manhole risers, flat lids, grade rings and manhole base sections shall be designed, by manufacture, to requirements of ASTM C 478 and ASTM C 857 as modified to accept polymer construction in lieu of concrete as follows:

- 1. Polymer Mixture – the mixture shall consist solely of thermosetting resin sand and aggregate. No cementitious materials shall be allowed.
- 2. Required wall thickness for all members will be that stated by polymer manhole manufacturer based upon loading conditions and material properties. The minimum wall thickness for risers and bases shall be 3 inches. The minimum thickness for flat lids shall be 1 foot. The wall thickness of risers and flat tops shall be not less than that prescribed by the manufacturer's design by more than 5%. A wall greater than the prescribed design shall not be cause for rejection.
- 3. Thermosetting Resin – The resin shall have a minimum of deflection temperature of 158° F when tested at 264 psi (1.820 mPa) following Test Method D648. The resin content shall not be less than 7% of the weight of the sample as determined by test method D 2584. Resin selection shall be suitable for applications in the corrosive conditions to which the structures will be exposed.
- 4. Each manhole component shall be free of all defects, including indentations, cracks, foreign inclusions and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. The internal diameter of manhole components shall not vary more than 1%. Variations in height of two opposite sides of risers and conical tops shall not be more

than 5/8 inch. The under run in height of a riser or conical top shall not be more than ¼ in/ft. of height with a maximum of ½ inch in any one section.

5. Marking and Identification – Each manhole shall be marked on the inside and outside with the following information – Manufacturer’s name or trademark, Manufacturer’s location and Production Date.
 6. Manhole joints shall be formed with a flush flat end, alignment guides and gasket so that on assembly, manhole base, riser and top section make a continuous and uniform manhole. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that would affect joint integrity.
 7. Minimum clear distance between two wall penetrations shall be a minimum of 6” on 48” to 72” diameter manholes and a minimum of 8” on larger diameter manholes. A clearance of 3” is required between wall penetration and joint.
 8. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe manhole connections. Invert slope through manhole is as indicated on drawings. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts. Unexposed support areas for enclosed invert and bench areas may be constructed of fill material and coated with a covering that will interlink with wall resins to prevent fill material corrosion.
 9. Provide resilient connectors conforming to requirements of ASTM C 923 or as required by the District Engineer. All connectors are to be watertight. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer’s instructions.
 10. Exceptions to ASTM C 478 – components shall be designed for the intended combinations of manufacturing materials. Component designs may be as non-reinforced members or reinforced members as recommended by the manufacturer. Steel reinforcement is not required for circumferential reinforcement, joint reinforcement, base slab reinforcement or hoop reinforcement, but may be placed for the purpose of product handling.
 11. Polymer manholes shall not contain any ladder rungs or ladders.
- J. Grouting
1. All materials needed for grouting and patching will be a polyester mortar compound provided by the manufacturer or an approved equal.

3.4 Grease Interceptor

- A. Provide and construct a minimum of 1,000-gallon pre-cast concrete grease interceptor. Grease interceptor shall have a minimum of 4-inch inflow and outflow pipe of PVC SDR-35 sewer pipe.
- B. The grease trap will be added to the district’s pre-treatment cleaning and testing list and the owner will be responsible to keep the interceptor maintained by cleaning it regularly depending upon the amount of grease that is introduced into the grease trap.
- C. Inspections are required before making a connection to the Districts Sewer main. Inspection and Impact Fees will need to be paid before connecting to the district’s sewer main.
- D. Use Dura-Crete, Old Castle or Amcor grease interceptor.

3.5 Sewer Flow Meter

A. Submittals

1. Provide component construction data, meter data, manhole data, flow transmitter and depth sensor data, temperature sensor data, controller data, connection wiring drawings and details.
2. Shop drawings shall be submitted.
3. If required, indicate special procedures required to install products specified.
4. Certify that products meet or exceed specified requirements.
5. Provide recorded location of all facilities.
6. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

B. Materials

1. Support: Contractor shall provide supports and mounting posts, poles and rails as required, sized to support the specified equipment and communications antenna and solar power panels.
2. Prefabricated Manhole with Integral Flume: Flume shall be full-length molded fiberglass reinforced polyester and shall be of an appropriate throat width and operating range for the intended use. Manhole manufactured by Virtual Polymer Compounds or approved equivalent.
3. Controller: Siemens Milltronics Continuous measurement Open Channel OCM III Ultrasonic Controller wall mounted indicator transmitter, housed in a NEMA 4X enclosure complete with one weatherproof power outlet.
4. Temperature Sensor: Siemens TS-2 Temperature Sensor
5. Flow and Depth Sensor: Echomax XRS-5 Ultrasonic continuous level measurement transducer as manufactured by Siemens.
6. Flow Meter, Depth Sensor, and Flow Transmitter: Flow meter including depth sensor and flow transmitter shall be ultrasonic type. The system electronics for the flow transmitter shall measure and convert the time lapse between transmitted and received ultrasonic signal at the sensor into a usable current signal. The electronics shall also compensate the liquid level signal for the time delay variation caused by temperature changes and then characterize the resultant signal by the “flow-to-head” curve for the respective flow element being monitored to yield a 4-20mA_{dc} output signal that shall be linearly proportional to flow. The 4 mA_{dc} value of the output signal shall correspond to zero head and a zero flow, while the 20 mA_{dc} value of the output signal shall correspond to maximum head and maximum flow for the open channel flow metering equipment being installed.
7. Fiberglass Grating: Square Duragrate Molded Fiberglass Grating or approved equivalent and required stainless steel supports.
8. GE PLC: Contractor shall provide a GE Versamax PLC with CPU E-05 Power Supply PWR202 and Analog Input Card ALG262.
9. Communication Equipment
 - a. Radio
 - i. Contractor shall provide a GE MDS INET 900 IP radio with PCTEL Maxrad 710-970 MHz Yagi Antenna and all required connectors and cabling. Cable shall be ½” Heliac Times Microwave LMR-600 or equal.
 - b. Contractor shall provide a PolyPhaser IS-50NX-C2-MA Lightning Protector or equal. The lightning protector shall be bulkhead mounted on the antenna cable entrance into the equipment enclosure.

- c. Contractor shall provide a grounding kit Wireless Solutions WGK-U2H5-UT or equal.
- 10. Solar Power System (where necessary)
 - a. Solar Panels
 - b. Batteries
 - c. Mounting Hardware
 - d. Solar Power System shall be designed to provide two consecutive cloudy days, including nights, during the wintertime. The system shall be designed to provide a continuous power assuming radio transmissions every 20 seconds for 4 second duration.
- 11. Appurtenant Items
 - a. Equipment Enclosure
 - i. Contractor shall provide corrosion resistant NEMA 4X enclosure.
 - b. Grounding System: Contractor shall provide ground rods and grounding in accordance with manufacturers' recommendations.
 - c. Conduits and Wiring: Contractor shall provide all conduits and wiring for electrical power and signal transmission required for a complete and functional installation. All connections shall be weatherproofed and suitable for the outdoor location.
 - d. Support: Contractor shall provide supports and mounting posts, poles and rails as required, sized to support the specified equipment and communications antenna and solar power panels.
- 12. Miscellaneous Components: Other items shall be corrosion resistant as approved by the District Engineer.

3.6 Sewer Lift Stations- For Public Stations in Capital Facilities Plan and Approved by District Only

A. Components

1. Dakota Pump Dry Well Pump Housing and Construction to match existing District pump stations. Include Ship Ladder Access with maximum of 10 feet and platform.
2. Pumps: As manufactured by Flygt and including Neva-clog or N series impellers and seal failure protection. Three phase power shall be supplied where available.
3. Hatch: Shall be Safe-Hatch as manufactured by Flygt. Size as indicated on the drawings. Hatches shall be manufactured of aluminum with heavy-duty stainless-steel hardware with a minimum 300 pounds per square foot load rating.
4. Stand by Generators: Diesel fueled standby generator as manufactured by Cummins.
5. Bio-Rem Odor Control System
6. Control Panels: As fabricated by Utility Management Systems, Inc. and including the following features/functions.
 - a. Cellular remote monitoring equipment as required by the district.
 - b. NEMA 4X with stainless steel dead front enclosure and aluminum inner door.
 - c. Incoming power terminals with neutral and ground terminations.
 - d. NEMA rated circuit breakers.
 - e. NEMA rated motor starters with overload for each pump.
 - f. NEMA rated control circuit breakers.
 - g. NEMA rated control voltage transformer. If 460 B or 230V three phase panel.
 - h. NEMA 4X hand off automatic selector switches.
 - i. Run lights.
 - j. Elapsed time meters.
 - k. High level alarm light with flasher.
 - l. Alternator.
 - m. Pump thermal and level sensor terminal strips.
 - n. 50W heater with thermostat.
 - o. Phase monitor.
 - p. Surge arrestor.
 - q. Single phase capacitor kits on single phase panels.
 - r. UL 508 serialized.
7. Level Control: Multitrode level control system and a backup float set above alarm level as manufactured by Flygt.
8. Cast In Place Wet Well: Design approved by District with Conshield.
9. Provide appropriate size flexible sleeves of synthetic rubber, with stainless steel clamps and bolts, for all gravity pipe openings in base section, Kor-N-Seal flexible type boot or equal.
10. Automatic Flush Valves: Automatic sump desludging flush valve as manufactured by Flygt.
11. Check Valves: Corrosion resistant ball type check valves as approved by the District Engineer or his or her designee.
12. Isolation Valves: Corrosion resistant eccentric plug valves as approved by the District Engineer or his or her designee.
13. Ventilation: Corrosion resistant ventilation as approved by the District Engineer or his or her designee.
14. Alarm System: As provided by Utility Management Systems, Inc.

15. Video Camera System for security
16. Miscellaneous Components: Other items shall be corrosion resistant as approved by the District Engineer or his or her designee.
17. 8-foot-high Pre-Case Concrete Wall: As approved by the District Engineer.
18. Vertical Pivot Electric Gate 16 feet wide
19. SCADA: Meet districts requirements and coordinate with APCO.

3.7 Sewer Installation

A. Excavation and backfill.

1. Earthwork for pipe trenches shall include trench excavation, providing and placing bedding, borrow for backfill and bedding, backfill within the pipe zone, backfill above pipe zone, shoring, compaction of material, and consolidation of material.
2. Standards. All applicable standards and rules applying to pipe excavation and installation shall be strictly adhered to, including, but not limited to, the following:
 - a. Specifications for excavation on State Highways, latest revision.
 - b. General Safety Order Covering Utah Industries - Section 69, trenches.
 - c. United State Department of Labor OSHA Publication 2085 - "Employer - Employee, Safe Practice for Excavation and Trenching Operation".
 - d. Utah Occupational Safety and Health Rules and Regulations - General Standard (UOSHA).
 - e. AASHTO T-180.
3. Excavation.
 - a. Excavation shall be accomplished to allow the pipe to be laid to the line and grade shown on the drawings or as directed by the District Engineer.
 - b. The Contractor, at his option, may leave all or part of the trench unshored or unbraced. If this is the case, the sides of the trench shall be sloped to meet safety standards. Trenches less than four feet deep may be constructed with vertical walls.
 - c. The District Inspector may require that unsuitable materials located beneath the pipe zone be over-excavated, backfilled and compacted to 95% maximum density as defined in AASHTO T-180.

B. Compaction

1. Compaction of materials located above the pipe zone shall be in accordance with requirements of the authority having jurisdiction over the road.

C. Alignment & Grade

1. Sewer lines shall be constructed in a straight line between manholes, in accordance with the approved plans. Lines shall be constructed to slope uniformly between manholes without bellies or sags. Grades shall be consistent with the approved plans.

D. Sewer Main line Pipe

1. Sewer main lines shall be installed in public rights-of-way or within District easements.
2. Verify that trench cut is ready to receive Work and excavations, dimensions, and elevations are as indicated on Project plan and profile drawings.
3. Where required by the District Inspector and/or District Engineer, install fabric encasement as indicated on drawings and according to manufacturer's written instructions and recommendations.
4. Install pipe, fittings, electronic markers and accessories, for sewer main lines, in accordance with appropriate ASTM standards and manufacturer's instructions. Seal joints watertight.
5. Unless otherwise approved by the District Engineer, pipe shall be laid to the alignment and grades indicated on the approved Construction Drawings within the following limits.

- a. Alignment – 2”
- b. Elevation - $\pm \frac{1}{2}$ ”
- c. When pipe is designed and/or installed within $\pm 0.1\%$ of the minimum allowable grades, as defined in Section 1.6 Sewer System Design Standards the variation in grade listed above shall not be applicable.
- d. The district reserves the right to require whatever action is necessary to correct (including replacement of all affected sections of line) any unacceptable results of pipe installations at less than minimum allowable slopes.
- e. A minimum of four (4) feet of cover shall be required over all main sewer lines.
- f. Pipe plugs shall be installed during construction at the end of each length of pipe installed to prevent water and debris from entering pipe.
- g. Install electronic markers over all HDPE and curved sewer lines, at intervals as per the manufacturer’s recommendations and as directed by the District Inspector but not more than twenty (20) feet, and at depths no greater than four (4) feet.
- h. In locations with steep slopes (i.e. greater than 15%) concrete anchor restraints shall be installed on the pipe at spacing and in a manner as indicated on the standard detail Drawing SS10.

E. Sewer Laterals

- 1. Sewer service lateral shall extend from a wye branch or other fitting as approved by the District Inspector, installed in the main line, to a point at least ten (10) feet inside the property line, as indicated on the drawings and as directed by the District Inspector.
- 2. Verify that trench cut is ready to receive Work and excavations, dimensions, and elevations are as indicated on Project plan and profile drawings, and as directed by the District Inspector.
- 3. Install pipe, fittings, and accessories, for sewer laterals, in accordance with appropriate ASTM standards and manufacturer’s instructions. Seal joints watertight.
- 4. Install a 22 $\frac{1}{2}$ or 45-degree bend, or combinations of bends as required, on the wye, rotated so the proper alignment and grade is established.
- 5. Install pipe to alignment as directed by the District Inspector and with uniform slope, free of low spots or adverse grades. Recommended minimum slope shall be $\frac{1}{4}$ -inch per foot (approximately 2.0 percent grade) where practical; but in no case less than $\frac{1}{8}$ -inch per foot (approximately 1.0 percent grade).
- 6. Where laterals are to be connected to a manhole, the manhole wall shall be core-cut with the appropriate size machine and the lateral pipe shall be connected to the manhole with appropriate type flexible coupling.
- 7. Service laterals shall be cleaned, flushed and tested in accordance with applicable requirements of this Section. After flushing has been complete, the end of the service lateral shall be beveled and plugged, with a Burke Duo Seal Pipe Plug or equivalent equal as per District Inspector’s requirements. Prior to backfilling a 2x4 shall be extended to the surface for future location.
- 8. A brass lateral marker shall be installed in the curb, directly above each lateral crossing, as per the District Inspector’s instructions. If curb and gutter are not available in a subdivision, brass lateral markers shall be installed as per the District Inspector’s instructions.
- 9. A minimum of four (4) feet of cover is required over all sewer laterals, unless otherwise approved by the District Engineer.
- 10. The district recommends that no trees be planted in the proximity of laterals.
- 11. Cleanouts shall be installed at not more than one hundred (100) feet spacing.
- 12. No more than two bends in excess of forty-five (45) degrees shall be installed without a cleanout.
- 13. Flows discharged from a sump shall be pumped, by automatic pumping equipment, via a pressure Sewer Lateral and discharged into a gravity flow Sewer Lateral, connecting at a

cleanout, or the Sewer Main, connecting in a manhole constructed of Dynastone with approved restrained coupling(s).

14. Pumping equipment and pressure Sewer Laterals shall be designed to meet or exceed the anticipated use requirements. Unless otherwise approved by the District Engineer, pressure Sewer Laterals shall be constructed of HDPE and constructed on a constant reverse grade. Professional advice should be obtained prior to installing pumping equipment, which shall be done per manufacturer's recommendations.

F. Installation – Casing Pipes

1. See Sections 4.1 Trench Excavation and 4.2 Trench Backfill and Compaction for trench excavation, backfill, and additional requirements.
2. Install casing pipes by ramming process, bore and jack, or open cut where indicated as that method to be acceptable to the District Inspector and any other governing authority. If the open cut installation method is used under a canal, river or other such area, the impacted area shall be lined with concrete, conforming to the governing authority requirements.
3. Install casing pipes at the line and grade as required to allow carrier pipes to be installed within the casing pipes at the design line and grade, as indicated on the drawings.
4. Place casing insulators on carrier pipes to properly center and position carrier pipe inside the casing pipes; space insulators as recommended by the pipe and/or insulator manufacturer.
5. Seal each end of casing with appropriate size flexible end seals; install according to manufacturer's instructions and recommendations.
6. Seal voids created by bore, around periphery of casing, with grout or impervious clay as approved by the District Inspector.
7. The contractor shall be solely responsible for the accuracy, safety and adequacy of construction methods and procedures for installing casing pipes, and for any damage which may result from their failure. All operations of the Contractor for installation of casing pipes shall be subject to approval by the agency having jurisdiction over the item being crossed, such as the Flood Control Department, Utah Department of Transportation, canal companies, and railroad companies.
8. Contractor shall enter into any agreement with and furnish any and all indemnity and other bonds that may be required by the agencies listed above, for their protection against injury and interference with flow of water caused by the operations of the Contractor.
9. Contractor shall secure required permission from the agencies referenced above before commencing with the installation of casing pipes and related Work along and across the respective areas.

G. Connections to Existing Sewer Manhole

1. Connection of Project pipe into an existing manhole includes:
 - a. All excavating required for the connection; and backfilling excavations after the connection is completed and compacting backfill as required.
 - b. Removing existing pipes where and if required.
 - c. Cutting hole through wall and base of existing manhole with appropriate size coring machine as required and as directed.
 - d. Installing new pipe in place and connecting to manhole wall with appropriate type flexible coupling, as recommended by the coupling manufacturer.
 - e. Reforming manhole floor and invert channel to provide smooth channel transitions to accommodate new connected pipes.
 - f. Sealing around new pipe where it intersects manhole wall, make connection watertight.
 - g. Perform all other operations necessary to restore existing manhole to condition acceptable to the District Inspector.
 - h. If existing manhole does not have steps, connection shall also include furnishing and installing new manhole steps. Steps shall be installed as described in Section 3.3.

- i. Connection to existing manholes shall not be completed until new pipelines have been cleaned, tested, and accepted by the District Inspector.
 - j. No debris and rubbish from new pipelines or manholes shall be flushed into existing District sewer pipelines.
- H. Connect Project Pipe to Stub at Existing Sewer Manhole
 - 1. Connection of Project pipe to stub at existing manhole includes:
 - a. All excavating required for the connection; and backfilling excavations after the connection is completed and compacting backfill as required.
 - b. Removing plug from end of existing pipe stub and cleaning end of pipe as required.
 - c. Connecting new pipe to end of pipe stub with appropriate rigid type coupling; connection to be watertight.
 - d. Perform all other operations necessary to restore existing manhole to condition acceptable to the District Inspector.
 - 2. If existing manhole does not have steps, connection shall also include furnishing and installing new manhole steps. Steps shall be installed as described in Section 3.3, Manholes.
 - a. Connections to existing manholes shall not be completed until new pipelines have been cleaned, tested, and accepted by the District Inspector.
 - b. No debris and rubbish from pipelines or manhole shall be flushed into District's existing pipelines.
- I. Quality Control of Pipe
 - 1. Clean and flush new Sewer Main Lines as follows.
 - a. Take every precaution to prevent dirt, grease, and all other foreign matter from entering each length of pipe before making connections in field.
 - b. After each section of piping is installed, it shall be thoroughly cleaned to remove rocks, dirt, and other foreign matter by washing, sweeping, scraping or other methods that will not harm the pipe.
 - c. For safety and to prevent rocks and other foreign matter from entering pipe, all open ends of pipe shall be plugged when workmen are not on the job or in the immediate area.
 - d. All sections of sewer lines between manholes and sewer laterals extending from the sewer main shall be completely flushed.
 - i. Pipe 12" diameter and larger shall be flushed at a rate of 3.0 feet per second.
 - ii. Pipe under 12" diameter shall be flushed at a rate of 4.0 feet per second.
 - e. The Contractor shall furnish the water required for flushing and testing.
 - f. All temporary cross-connections for flushing and drainage shall be furnished, installed, and subsequently removed by the Contractor after completion of the operation.
 - g. No debris and rubbish from pipelines or manholes shall be flushed into District's existing pipelines.
 - 2. Perform field inspection and testing in accordance with Section 4 INSPECTION AND TESTING
 - 3. Prior to the backfilling of a trench, the District Inspector shall inspect pipe installation; backfilling will be done only after the District Inspector authorizes it.
 - 4. The Contractor shall arrange for all inspections.
 - 5. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to District.
 - 6. Test for Leakage: Test all pipe, fittings and other items for leakage, in the presence of District Inspector, after items have been cleaned. Tests shall be done by independent testing company. All joints, couplings, and fittings shall be watertight.

- a. Infiltration Test: Infiltration test required when pipe is below ground water level. The amount of water leaking into the pipe shall be measured. Leakage into pipe shall not be more than 1 gallon per day per inch diameter per mile of pipe.
 - b. Air Test: Low-pressure air test may be performed. The section of pipe being tested shall be sealed; line being tested shall be pressurized to approximately 4.0 psi; and pressure allowed stabilizing for a minimum of two minutes. During this period, air shall be added if the pressure drops below 4.0 psi. After this stabilization period, timing shall begin. The time of test, in minutes, shall be equal to the pipe diameter in inches. The maximum allowable pressure drop during the specified time period shall be 0.5 psi.
7. Deflection Test – HDPE, Fiberglass, and PVC Sewer Pipe: After sewer pipe has been cleaned, perform deflection test on each section of pipeline between manholes, where required by the District Inspector. The maximum allowable pipe deflection, the reduction in vertical inside diameter, shall be 5 percent. Maximum allowable deflection shall be applied to the base inside diameters shown in Table 10.14, Base Inside Diameter for Deflection Measurements of ASTM D 3034 SDR35 PVC Sewer Pipe, Table 10.15 Base Inside Diameters for Deflection Measurements ASTM F 679 or Table 10.16 Base Inside Diameters For Deflection Measurements ASTM 794 in the Uni-Bell “Handbook of PVC Pipe”, to determine minimum permissible diameter, or other appropriate sources. Testing devices shall include a deflectometer, calibrated television or photography, or properly sized mandrel.
8. Televised Inspection: After the sewer pipe has been installed and cleaned and the trench has been filled, the district will televise the sewer pipe to locate defects in the sewer pipe.
- a. The Contractor shall arrange for the televised inspections.
 - b. The Contractor shall ensure safe access to each manhole for the district’s television truck.
 - c. If the District is called for a televised inspection and cannot perform such inspection due to defects in Work by Contractor, i.e. inaccessible manholes, dirty sewer pipe, etc., the Contractor shall be charged a call back fee according to the current District Fee Schedule.
 - d. Any Work not conforming to these Design Standards and Construction Specifications shall be promptly removed, replaced and retested at no cost to the district.
9. Hydrostatic Test
- a. A hydrostatic test shall be performed on the following installed pipes:
 - i. Force Sewer Main Lines.
 - ii. Private pressure Sewer Laterals.
 - b. Prior to the hydrostatic test, the line shall be flushed with an adequate flow volume and rate to remove any debris, silt, gravel or other material in the line.
 - c. Method of Test:
 - i. The lines to be tested shall be filled with clean water.
 - ii. All air in the system shall be expelled before the test.
 - iii. The test pressure shall be the greater of 150% of the maximum design pressure or 100 psi.
 - iv. Leakage shall not be permitted.
 - v. Locate and repair defective joints and retest until leakage rate is less than allowable.
 - vi. Repair any noticeable leakage even if total leakage is less than allowable.

J. Protection

- 1. Protect pipe and bedding material from damage or displacement until backfilling operation is in progress.

K. Bedding

1. All sewer pipes shall be bedded in free draining granular backfill. Crushed gravel gradation shall pass the ¾” screen, and none shall pass the 3/8” screen. Bedding shall be placed at a minimum of 6” below the pipe and 12” above the pipe. Sand bedding or the use of other bedding materials is not permitted.

L. Manholes.

1. Precast Base. Flexible sleeves of synthetic rubber with stainless steel clamps shall be provided in all pipe openings in pre-cast bases. After the pipe is clamped in place, openings around the sleeves shall be filled with cement grout. Install precast concrete manhole base level on a compacted foundation.
2. Base Gravel. Pre-cast bases shall be found on gravel or other material satisfactory to the District Engineer, of minimum thickness indicated on the drawings.
3. Cast Base. Cast-in-place bases shall not be permitted without approval of the District Engineer and shall be as indicated on the drawings. Surfaces of the water channel and interior shall be float finished. Concrete shall conform to Section 2.3.
 - a. After manhole has been completed, saw-cut into top of existing sewer pipe, remove section of pipe as required, and dispose of the removed material; construct pipeline, as directed. Invert channel shall be formed to direct sewage flows through the manhole as indicated.
 - b. Divert existing sewage flows around the work area to allow connection to existing pipeline to be made.
4. Pipe Openings. A plastic seal or water stop shall be installed to make watertight connections in manhole pipe openings.
 - a. Place manhole riser section plumb and level, from the manhole base to top section, as indicated and according to manufacturer’s instructions; anchor to base: align steps perpendicular to sewer line, and seal joints.
 - b. Place top section, cone section or flat slab, on top riser section, with opening positioned oversteps. The top of cone section or flat slab shall be from 10-inches to 18-inches below final surface elevation, as directed by the District Inspector.
5. Grade Rings. Precast grade rings shall be provided as required to adjust the height of the manhole. A maximum of 2 grade rings, not to exceed 12” total height, is permitted in new construction. Brick shall not be used in lieu of, or in addition to, grade rings. Cast-iron grade rings are not permitted. The manhole shall be provided with a concrete collar, and the finished product shall be parallel to and one-half inch below the asphalt road grade. (See standard drawings).
6. Connect pipe to manhole with appropriate type flexible coupling as recommended by manufacturer. Provide pipe joint or flexible coupling on all pipes approximately 18” from outside of manhole. Grout around pipe after installation is complete. Make connections watertight.
 - a. Provide sewer pipe stubs for future connections of the same type of pipe used on the Project, and of the size indicated.
 - b. Alignment and grade of stub to be determined by the District Inspector.
 - c. Install permanent, watertight plug or cap on end of stub, outside of the manhole.
 - d. Grout inside of manhole base sections to form channel between connected pipes, as indicated. Trowel smooth. The top of the channel shall be at the same elevation as the top of outlet pipe.
 - e. Set cover frames and lids to match street elevation and slope. After placement, grout around the exterior of frame from top of concrete top section to top of frame, as indicated, to ensure watertight condition.
 - f. After manhole base has been completed, furnish and install temporary pipe plugs to seal all interior pipe openings; plugs to be Brandt Duo Seal Pipe Plug by Burke

Rubber Company, Cherne Pipe Plug by Cherne Manufacturing Company, or acceptable equal. Pipe plugs shall remain in place until final review and acceptance of completed sewer. Plugs shall then be removed; and shall be property of Contractor.

7. In paved areas, collars shall be constructed around manhole covers as indicated. Collars shall be constructed of either concrete or bituminous asphalt; and shall be constructed after new pavement has been placed and accepted by the District Inspector and/or Local Governing Body. Concrete collars shall contain synthetic fiber reinforcement as per “Cast in Place Concrete” Section 5.1 CONCRETE.
8. Manholes which are located in unimproved areas (not in a finished, paved road) shall have the rim raised above surrounding grade to minimize surface water infiltration.
9. Manholes placed in roadway shoulders, within 10 feet of the edge of pavement shall be set horizontal and extend two to four inches above finished grade, allowing for access, maintenance and drainage, and to minimize adverse effects of snowplows.
10. Debris in Manholes. Manholes are to be kept clean during construction. Plywood or prefabricated false bottoms are to be used through all construction phases, until the manhole has been raised to grade and grouted.
11. Cure time. Precast concrete products shall not be installed until seven days have passed since the product has been manufactured. The date stamped on the concrete product will be used as the starting date in determining this time period. Any concrete product installed within this seven-day period will not be accepted by the District Engineer and will be required to be removed and replaced.
12. Signs. Manholes which are not located in a dedicated Right-of-Way shall have a sign posted near the manhole so that it may be easily located. The sign will be provided by KID. The developer is responsible for providing a metal post, and placing it near the manhole, so that the sign will be approximately 4 feet above grade.
13. Drop Manholes. Drop manholes are not allowed unless approved by the District Engineer.

M. Connections to Main

1. Connections to main (laterals). All pipe and fittings shall be PVC plastic meeting requirements stated in Section 2.2.1.1. Fittings shall be shop-fabricated. Joints shall be rubber gasket. Welded joints may not be used. A flexible connection shall be provided for manhole connections. Connections shall be a minimum of 30 degrees above the horizontal centerline. Provide cleanouts as required by the Plumbing Code. Laterals shall be extended to 15 feet past the property line and identified with a 2x4 location board.
2. Coordinate with other sections of work to provide correct size, shape, and location.

N. Proximity to Water lines

1. Separation between sewer and water lines shall conform in every way to the State of Utah Division of Drinking Water requirements. Sewer lines shall be located at least 10 feet horizontally from culinary water lines. Where such separation is not possible, the water line shall be located above the sewer line on an excavated shelf or in a separate trench, maintaining at least 18” vertical separation.
2. Where sewer and water mains must cross and the vertical separation required above is not possible, water mains shall be constructed of mechanical-joint ductile iron pipe, or equivalent, for a distance of 10 feet on either side of the point of crossing.

O. Flushing and testing

1. Sewer lines shall be kept clean and free from debris during construction. Flushing and testing shall be in accordance with Section 3.8.

P. Grease Traps

1. Grease traps (grease Interceptors) shall be a minimum of 1000 gallon capacity, shall be precast concrete, and shall be consistent with the standard drawings. Grease traps shall be

provided for all commercial or industrial properties where the discharge of fats, oils, or grease may occur in excessive quantities as determined by the District Engineer. An approved sampling station shall be located immediately downstream of the grease trap.

Q. Sewer Flow Meter

1. Install all equipment furnished under this Section in accordance with appropriate ASTM standards, construction drawings and in accordance with manufacturer's recommendations.
2. All equipment specified in this Section shall be electrically complete, in that the Contractor is required to furnish and install exterior power, signal wiring, conduits, fittings, etc. necessary for complete operation. Labeled terminal strips shall be provided.
3. Sewer Flow Monitoring Station
 - a. Construct sewer flow monitoring station at manhole shown, as acceptable to the District Inspector. The antenna shall be mounted 12" above finished grade on a 2" minimum diameter mast with weather head unless shown otherwise. Equipment enclosure shall be rail mounted 4' above finished grade unless shown otherwise. Solar Panel (where applicable) shall be mounted 9' above finished grade unless shown otherwise. Rails shall be adequately supported with concrete bases to provide a sturdy installation.
 - b. Install equipment as per manufacturer's recommendations and as acceptable to the District Inspector. Provide 1 day of startup by manufacturers' representative to calibrate and startup equipment.
4. Quality Control
 - a. Final field test for each flow metering system shall demonstrate the following:
 - i. That the flow metering system has been properly installed, properly calibrated, and is functioning as specified.
 - ii. That the flow metering system indicates the correct flow for two different depths of flow for the flume.
 - iii. That the correct flow generated output signal is provided from each flow transmitter to the data logger.
 - iv. That the flow data can be stored in memory and viewed on a data logger display.
 - b. That the flow data can be transferred to a PC computer and stored in a data file.

R. Sewer Lift Stations

1. Where native material that is encountered at the foundation depth of the lift station is considered unsuitable, remove unsuitable material; and place and compact bedding material to limits directed by the District Inspector.
2. Construct lift station as per the approved Design Drawings.
3. Unless otherwise approved by the District Engineer, lift stations will require three phase power.
4. Install precast concrete base level on a compacted foundation, according to manufacturer's recommendations.
5. Install top fiberglass base according to manufacturer's recommendations.
6. Place riser sections plumb and level, from the concrete base to the top section, as indicated and according to manufacturer's instructions, anchor to base and seal joints. No steps will be allowed in lift stations.
7. Place flat slab, on top riser section, with opening positioned to allow easy removal and replacement of each pump.
8. Connect gravity pipes to station with appropriate type flexible coupling as recommended by manufacturer. Provide pipe joint or flexible coupling on all pipes approximately 18 inches from outside of manhole. Grout around pipe after installation is complete. Make connections watertight.

9. Set hatch level to correct elevations. A hole shall be installed in hatch for testing of wet well atmosphere. A hole must be provided in the hatch for atmospheric testing as per the District Inspector's instructions.
10. Install all components as per manufacturer's recommendations.
11. Construct concrete valve vault as indicated on the design drawings.
12. Construct corrosive resistant ventilation components as indicated on the design drawings.
13. The entire site shall be paved with 3 inches of asphalt over 8 inches of compacted road base.
14. A 6-foot-tall vinyl fence shall be installed around the perimeter of the site, with a 12-foot double swing locking gate.
15. An emergency yard light shall be installed at the site.
16. The site shall include a permanent receiving bracket for a portable crane to be used in removing and replacing the pumps.
17. All electrical systems and components (i.e. Motors, lights, cables, conduits, switchboxes, and control circuits) shall be installed as per the manufacturer's recommendations.
18. Electrical systems and components (motors, lights, cables, conduits, switchboxes, control circuits) in wet wells or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electrical Code requirements for Class 1, Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided. When such equipment is exposed to weather, it is to meet the requirements for NEMA 3R.
19. An alarm system shall be installed according to the manufacturer's recommendations.
20. Standby generator shall be installed per manufacturer's recommendations. Provisions shall be made for automatic generator start-up and load transfer upon power failure.
21. Control panels and electrical equipment shall be located in a control building constructed in accordance with the following requirements:
 - a. The building floor plan and layout shall provide adequate space for the control panels and other electrical equipment and access for maintenance and repairs. The minimum inside dimensions of the control building shall be 8 feet by 12 feet. Minimum inside height shall be 8 feet.
 - b. The building shall be architecturally comparable with the existing buildings in the area, or the future buildings planned for the area.
 - c. At a minimum, the buildings shall be constructed of Atlas brick on concrete footings with a concrete floor. The roof shall be pitched, with a minimum slope of 4:12, with a 26-gauge standing seam steel roof, over ¾ inch plywood sheeting and building paper. The roof fascia and soffits shall be aluminum. The gables shall be Atlas brick. The interior of the roof shall be insulated with R-38 fiberglass batt insulation. The ceiling shall be 5/8-inch painted sheetrock.
 - d. The building shall have at least one 3 feet by 7-foot hollow metal man-door with metal frame, threshold, lock set and 12-inch square ventilation louver with insect screen.
 - e. The building shall have at least two fluorescent lighting fixtures with 4–40-watt lamps each, or LED equivalency, and two electrical outlets.
 - f. The building shall have a thermostat-operated ventilation fan with roof exhaust capable of providing 10 air changes per hour.
 - g. Building construction shall otherwise conform to the building code and other requirements of the local jurisdiction.
22. Field Quality Control
 - a. Lift Stations wet wells shall be tested by an independent testing company, using vacuum test method to demonstrate integrity of installed materials and construction

procedures. Method and material for repair shall be as acceptable to the District Inspector.

- b. Each station shall be tested immediately after assembly and backfilling.
 - c. Plug any lift holes with an acceptable non-shrink grout.
 - d. Plug all pipes entering station; securely brace plugs during test.
 - e. Test head shall be placed at inside top of cast iron frame, or as accepted by the District Inspector; and the seal shall be inflated in accordance with manufacturer's recommendations.
23. Testing shall conform to ASTM C 1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
 24. If the station fails the initial test, make all necessary repairs on the outside of box with non-shrink grout or other acceptable material. Box shall be re-tested until a satisfactory test is obtained.
 25. A factory-trained representative shall be present for startup and as necessary to provide training.

3.8 Sewer Inspections

A. Pressure tests

1. The Contractor shall retain an approved testing agency to perform the following leakage tests on all pipe installed, including laterals and/or service stubs. The methods and equipment used to make the test shall be mutually determined by the District Inspector and the Contractor before any testing is started. The Contractor shall, at his own expense, locate and correct any excess leakage and repair any damage to the pipe or its appurtenances indicated by, or resulting from, the test. For the purpose of testing, a section of the sewer shall be considered as the length of sewer between successive manholes. Any section that fails a test shall be repaired and retested at the Contractor's expense. Any excavation or surface restoration required in fixing leaks shall be in conformance with applicable standards.
2. An infiltration test will be required when the pipeline is below the groundwater level. The amount of water leaking into the pipe shall be measured and it shall not be more than 10 gallons per inch diameter per mile of pipe.
3. In areas where the groundwater is below the pipe, a low-pressure air test shall be performed. The section of pipe between successive manholes shall be sealed with suitable plugs. One of the plugs shall have an orifice through which to pass air into the section of pipe being tested. The air supply line shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range of from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of +/- 0.04 psi.
4. The line under the test shall be pressurized to approximately 4 psi. The air supply shall then be shut off and the pressure allowed to stabilize for a minimum of 2 minutes. If during this period the pressure drops below 3.5 psi, more air shall be introduced to raise the pressure to a minimum of 3.5 psi. After this stabilization period, the air supply line shall be disconnected, and timing shall begin. The time of the test, in minutes, shall be equal to the pipe diameter, in inches. The maximum allowable pressure drop during the specified time period shall be 1.0 psi. A copy of the successful air test report shall be provided to KID.

B. Compaction tests

1. Compaction tests shall be performed by qualified, independent soils testing firms in accordance with standards established by the prevailing authority for roads. Where

compaction of soil under or around pipes is required due to over excavation, testing shall be to not less than 95% in accordance with AASHTO T-180.

C. Mandrel testing

1. Sewer pipe shall, at the request of the District Inspector, be deflection tested by pulling a solid, pointed mandrel through the completed pipeline. The diameter of the completed mandrel shall be 95% of the pipe diameter. Testing shall be conducted on a manhole-to-manhole basis and shall be done after the line has been completely flushed with water. The Contractor shall be required, at his expense, to locate and repair any and all sections of the pipeline which fail this test and retest each such section.

D. Video Inspection.

1. As a prerequisite for final acceptance of all new sewer trunk lines (all sewer lines except service connections), the Contractor shall perform an internal television inspection and furnish to KID digital recordings which pictorially demonstrate that satisfactory watertight conditions exist at all joints in the lines, and that the pipe is free from deleterious cracks, leaks, deflections or other damaged conditions.
2. Television inspection shall be performed only after the sewer lines have been flushed and checked and accepted for grade and alignment and have been satisfactorily tested for infiltration and exfiltration. Standing or low flow running water shall be present to facilitate the detection of bellies.
3. Television inspection equipment and methods to be used by the Contractor in performing the internal television inspection and video recording shall be suitable to provide the video tape recordings specified next hereinafter and shall be acceptable to KID.
4. Digital Video Recordings: Digital Video Recordings of sewer line inspections shall be provided on DVD format or Flash Drive Technology. The audio portion of the composite signal shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report. Audio reports shall be recorded by the operating technician on the video tapes as they are being produced and shall include the location of the sewer, the names or numbers of the manholes involved, a manhole-to-manhole direction of travel, and a description of the conditions in the sewer line as they are encountered. The purpose of the video tape recording shall be to supply a permanent visual and audio record of the sewer pipe section, and the video tapes shall become the property of KID upon completion of the Project.
5. A schematic drawing of the sewer system, showing all manholes and connecting lines, shall be provided. The schematic shall indicate the direction of the camera and shall include a sequential numbering system beginning with the first manhole in the survey to the last. A north arrow shall also be provided. Any other documentation that is necessary to understand the video survey should be included on or with the schematic.

E. Lateral Inspections

1. The lateral connecting the structure's DWV system to the stub installed by the Developer (see Drawing SS4) shall be inspected by the INSPECTOR for conformance to the Plumbing Code and these Design Standards and Specifications.

4.0 TRENCH EXCAVATION

General - Trench Excavation for the Work shall conform to the requirements of this section.

4.1 Trench Excavation

- A. Call “Blue Stakes” 48 hours in advance of excavation work to mark existing underground utility locations. Verify locations and elevations of existing utility lines in the area of the Work. Protect all utility lines from excavating equipment and vehicular traffic.
- B. Verify that Survey benchmarks and intended elevations for the Work are as indicated. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, curbs, and other improvements from excavating equipment and vehicular traffic.
- C. Protect plants, lawns, and other features to remain.
- D. Notify utility company to remove and relocate utilities, where and as required.
- E. Trench Excavation
 1. Excavate trenches as required to allow Project pipe to be installed to design alignment and grade.
 2. Notify the District Inspector of unexpected subsurface conditions and discontinue affected Work in area until notified to resume Work.
 3. It is recommended that all trench excavation be done according to OSHA Standards and other applicable regulations,
 4. Do not interfere with adjacent foundations.
 5. Excavate trenches to width, depth and cross section as indicated on the trench detail drawings.
 6. Hand trim excavations. Remove loose matter.
 7. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.
 8. Remove excavated material that is unsuitable for re-use on the Project from site and dispose of in an acceptable manner.
 9. Where approved by the District Inspector, stockpile excavated material to be re-used in areas designated on site.
 10. Remove excess excavated material from site and dispose of it in an acceptable manner.
 11. During construction, provide and maintain sufficient means and devices to promptly remove and properly dispose of all water entering excavations or other parts of the Work.
 - a. Dispose of water from work area in an acceptable manner, without damage to adjacent property.
 - b. No pipe, concrete footings, foundations or floors shall be installed in water.
 - c. Water shall not be allowed to rise over concrete until it has been set for at least 24 hours.
 - d. Water shall not be allowed to rise against walls and supporting beams for a period of 14 days after completion of walls and beams.

- e. Any damage to pipe work or concrete work caused by water shall be repaired by the Contractor, at Contractor's expense.
 - 12. The use of explosives will **not** be allowed, unless specifically reviewed and accepted by the District Inspector and District Engineer. All blasting shall be done by a reputable contractor specializing in the use of explosives, who is acceptable to the District Inspector and District Engineer.
 - 13. The contractor shall provide, at no cost to the district, excavation and safety equipment for test holes used in quality assurance testing as directed by the District Inspector.
- F. Preparation for Water Line Placement
- 1. Cut out soft areas of subgrade not capable of compaction in place. Backfill with District approved sand bedding material or as directed by the District Inspector.
 - 2. Correct areas that are over-excavated and fill with granular borrow compacted to at least 95 percent by the modified Proctor method (ASTM D-1557). Then place District approved sand bedding material.
- G. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water

4.2 Trench Backfill and Compaction

- A. Separate differing materials with dividers or stockpile separately to prevent intermixing. Prevent contamination of the stockpiled material and protect from erosion and deterioration of the materials.
- B. No frozen materials shall be used as backfill.
- C. Backfill materials shall be free of organic materials.
- D. No manmade materials shall be used as backfill, unless otherwise approved by the District Engineer.
- E. Trench Pipe Zone and Backfill Materials
 - 1. Angular crushed washed stone (Gravel) approved by District for Sewer Pipe Zone: free of shale, clay, friable material, organic material and debris, all material being between $\frac{3}{4}$ inch and $1\frac{1}{2}$ inch in size, unless otherwise specified by the pipe manufacturer.
 - 2. Bank sand Approved by District for Water Pipe Zone: washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
 - a. Graded in accordance with ASTM C-136, within the following limits:
 - No. 4 sieve: 100 percent passing.
 - No. 14 sieve: 10 to 100 percent passing.
 - No. 50 sieve: 5 to 90 percent passing.
 - No. 100 sieve: 4 to 30 percent passing.
 - No. 200 sieve: 0 percent passing.
 - 3. Topsoil excavated on-site.
 - a. Graded.
 - b. Free of roots, rocks larger than $\frac{1}{2}$ inch, subsoil, debris, large weeds and foreign matter.
 - c. Acidity range (pH) of 5.5 to 7.5.
 - d. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 - e. Conforming to ASTM D2487 Group Symbol OL or OH.
 - 4. Material excavated during trenching operations.
 - a. May only be used as trench backfill if recommended by the geotechnical engineer of record and approved by the District Inspector and the District Engineer.
 - b. Geotechnical engineer of record shall define placement and compaction methods.
 - c. Contractor and/or Developer shall employ and pay for full time quality control services of the geotechnical engineer of record.
 - d. Upon completion of the project, the geotechnical engineer of record shall prepare a letter summarizing:
 - i. Testing methods, test frequencies and observations.
 - ii. Any non-conforming conditions (s) and corrective action(s) taken to remedy the non-conformity(ies).
 - iii. Compliance of the work to the project specifications.

5. Concrete for Fill: Flowable Fill with 60PSI for District or use UDOT current specs for flow fill in UDOT right-of-way.

F. Trench Backfill

1. Fill to finish contours and elevations indicated.
2. Fill up to subgrade elevations where indicated.
3. Employ a placement method that does not disturb or damage other work.
4. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
5. Maintain moisture content of fill materials within two (2) percent of optimum moisture as determined by ASTM D-698 or ASTM D-1557 to attain required compaction density.
6. Place and mechanically compact materials in equal continuous layers not exceeding 8 inches in compacted depth.
7. Reshape and re-compact fills subjected to vehicular traffic.
8. Pipe Zone:
 - a. Use Bank sand for water lines and Gravel approved by District.
 - b. Fill under, around and over water pipe as indicated on the “Standard Water Trench Detail” Drawing.
 - c. Use concrete flow fill material in areas of excessive cover over pipe, as directed by the District Inspector.
 - i. Excessive cover shall be determined by the pipe manufacturer and approved by the District Inspector.
9. Trench Backfill Above Pipe Zone:
 - a. Use local governing body’s specification.
 - b. Fill up to subgrade elevations or finish grade, as indicated.
 - c. Compact to at least 95 percent of the maximum dry density as determined by the modified Proctor compaction method (ASTM D-1557) or to local governing body’s specification, if more stringent.
10. Under curb and gutter, sidewalks, slabs-on-grade, and other concrete work:
 - a. Use granular fill.
 - b. Compact to at least 95 percent of the maximum dry density as determined by the modified Proctor compaction method (ASTM D-1557).
11. At Landscaped Areas.
 - a. Use borrow.
 - b. Fill up to 4 inches below finish grade elevations.
 - c. Compact to at least 91 percent of the maximum dry density as determined by the modified Proctor compaction method (ASTM D-1557) or to local governing body’s specification, if more stringent
12. After placement, compaction and testing of mechanically compacted backfill is completed, Contractor may utilize other compaction methods when accepted by the district.
13. Where required, restore surface to as near original condition as is reasonably possible.

G. Quality Control

1. All testing is to be done by an independent testing company for the Contractor or Developer; test results for all tests will be sent to the district within 24 hours after the tests have been completed.
2. Perform compaction, moisture and density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
3. Evaluate results in relation to compaction curve determined by testing material in accordance with ASTM D-1557 (“Modified Proctor”).
4. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
5. Frequency of Tests as directed by the District’s Inspector with at least one test for each 200 CY of material.
6. The District Inspector shall have the right to determine when and where all soil testing shall be performed.
7. The contractor shall provide excavation and safety equipment for test holes used in quality assurance testing as directed by the District Inspector, at no cost to the district.
8. The district may perform additional quality assurance testing to verify conformance with these specifications.
The contractor shall provide excavation and safety equipment for test holes used in quality assurance testing as directed by the District Inspector.

5.0 Concrete

General. Concrete for use in the Work shall conform to the requirements of this section.

5.1 Materials

	ITEM	DESCRIPTION	MANUFACTURER	MODEL
5.1 Concrete Materials				
	Type II Cement	General Use		
	Type III Cement	Ambient Temperature lower than 40°F		
	Type V	Sulfate Resistant – Exposed to Sewage		
	Air Entraining	Exposed Concrete -4% - 8%		
	Retarding Densifier	Water Reducer	Sika Chemical	
	Curing Materials	8 mil Polyethylene Sheet ASTM C309, Type 1 Clear or Translucent		
	Fibrous Reinforcement	1.5 lbs./cubic yard – minimum 1” long		
	Reinforcing Bars	Grade 60 steel		
	Slump	2” to 4”		

A. Cement. Cement shall conform to ASTM C150.

1. Type II low-alkali cement shall be used for all work, except that Type III low-alkali shall be used when the ambient temperature is lower than 40 degrees F.
2. Type V Sulfate Resistant Portland Type, when exposed to sewage.

B. Aggregates Concrete aggregates shall conform to the requirements of ASTM C33.

1. Coarse aggregates shall consist of crushed stone or gravel, graded to meet the grading requirements of ASTM C33. The maximum limits for deleterious substances in coarse aggregate shall be as listed in ASTM C33. The maximum size of coarse aggregate shall be as specified elsewhere for the type of concrete work but in no case larger than 2”. When not otherwise specified, aggregate shall be the largest size which is not larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, or three-fourths of the minimum clear spacing between individual reinforcing bars. Fine Aggregates.
2. Fine aggregate shall be within the following limits when tested in accordance with ASTM C136.

Sieve	Percent Passing
3/8”	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

Fine aggregate shall have not more than 45 percent retained between any consecutive screens.

C. Fly Ash. Fly Ash shall conform to ASTM C618, Class F.

- D. **Calcine Pozzolan.** Calcined Pozzolan shall conform to ASTM C 618, Class N.
E. **Synthetic Fiber Reinforcement** shall comply with ASTM C 1116; ½” length.

F. Water

1. Water shall be of drinkable quality; clean, fresh, and free of deleterious amounts of acids, alkalis or organic materials.
2. The quantity of mixing water measured into the batch shall be reduced by the amount of free water contained in the fine and coarse aggregates. The weight of coarse and fine aggregates shall be increased by the weight of water contained in them.

G. Admixtures.

1. Air-Entrainment. Air-entraining admixtures shall conform to ASTM C260.
2. Retarding Densifier. Retarding admixture shall be water-reducing and retarding type: Plastiment as manufactured by Sika Chemical Corporation or approved equal.
3. Curing Materials. Provide curing materials, when required, as follows:
 - a. Moisture Barrier. Moisture barrier shall be 8-mil polyethylene sheet, polyethylene-coated barrier paper, or 1/8-inch thick asphalt core membrane sheet.
 - b. Curing Compound. Curing compound shall be membrane-forming, conforming to ASTM C309, Type 1, clear or translucent.
4. CONSHIELD admixture when required for acid-resistance by the District Engineer.

H. Mix Design

1. Standard. Concrete mixes shall be designed using the absolute volume method as described in ACI 211.1. The concrete shall be 6.3 bag mix, with a maximum water cement ratio of 0.50, and shall be from an approved ready-mix plant.
2. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
3. Fibrous Reinforcement is to be added where indicated, add to mix at a rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific Project conditions.
4. Normal Wight Concrete:
 - a. Compressive Strength, per ASTM C 39 at 28 days: 4,000 psi.
 - b. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - c. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
 - d. Cement Content: Minimum 592.2 lb. per cubic yard; 6.3 bag mix.
 - e. Water-Cement Ratio: Maximum 48 percent by weight.
 - f. Total Air content: 4 to 6 percent for concrete exposed to freezing and thawing; and 2 to 4 percent for other concrete; per ASTM C 173.
 - g. Slump: 4 to 2 inches for structures; 3 to 1 ½ inches for blocks and pavement.
 - h. Maximum Aggregate Size: one inch.

I. Entrained Air

1. Use air-entraining admixture in all pavement and exterior concrete, providing not less than 5 percent or more than 8 percent entrained air for concrete exposed to freezing and thawing, to improve workability and durability and from 4 percent to 6 percent for structural concrete with less exposure to freeze-thaw.

J. Retarder

1. Add Plastiment or approved equal (0.2-0.6% by weight of cement), a water-reducing and retarding admixture, to the concrete mix when ambient temperatures exceed 85 degrees F. to extend setting time, reduce risk of cracking and improve workability. Retarder shall be added in amounts as recommended by the manufacturer.

K. Adjusted Mixes

1. Mix designs may be adjusted when material characteristics, job conditions, weather, test results or other circumstances warrant. The total water content per bag of cement shall not be exceeded. The cement content per cubic yard of concrete shall not be reduced. Do not use revised concrete mixes.

L. Grout

1. Provide cement grout mixture of 1 part Portland Cement to 3 parts fine aggregate (1/4-inch maximum), by volume, with minimum water required for placement and hydration. Adjust formulation as required for use of special admixtures. Admixtures used in grout shall be acceptable to the District Engineer.
2. Minimum Compressive Strength at 48 hours: 2,400 psi,
3. Minimum Compressive Strength at 28 days: 7,000 psi.

M. Epoxy Bonding

1. System per ASTM C881, type as required by Project conditions.

N. Joint Devices and Materials

1. Water stops: PVC type, COE CRD-C 572.
2. Joint Filler: ASTM D 1751; Asphalt impregnated fiberboard or felt, 1/2" thick with a tongue and groove profile.

O. Reinforcement

1. Reinforcing Bars. Steel for reinforcing bars to be embedded in concrete shall be deformed bars of the size indicated on the drawings. Bars shall be free from defect and kinks, and from bends not shown in the drawings. The bars shall conform to the requirements of ASTM A615. Bars shall be Grade 60. All bars shall be new stock, free from rust scale, mill scale, or excessive rust when placed in the work. A thin coating of red rust resulting from short exposure will not be considered objectionable; any bars having rust scale, mill scale or a thick rust coat shall be thoroughly cleaned or shall be rejected and removed from the premises upon the order of the District Engineer.
2. Reinforcing Mesh. The wire mesh or fabric shall be of the size, number of wires and weight indicated on the drawings or directed by the District Engineer. It shall conform to ASTM A185. All reinforcing mesh shall be of new stock, free from excessive rust when placed in the work.
3. Wire. Plain wire shall conform to ASTM A82-02.
4. Installing Reinforcement
 - a. Comply with the requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
 - b. Install wire fabric in maximum possible lengths and offset end laps in both directions. Slice laps with tie wire.
 - c. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

P. Mixing

1. Transit Mixers: shall comply with ASTM C 94.
2. During hot weather or under other conditions contributing to rapid setting of concrete, mixing times will be reduced as follows.

- a. When the air temperature is between 85 and 90 degrees (F), reduce mixing time and delivery time from 90 minutes to 75 minutes.
 - b. When the air temperature is above 90 degrees (F), reduce mixing time to 60 minutes.
3. Provide batch ticket for each batch used in the Work. Ticket shall indicate Project identification name and number, date, mix type, mix time, quantity, and amount of water added.

Q. Preparation

1. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
2. Forms shall be mortar tight, properly aligned, as indicated, to produce concrete surfaces meeting the surface requirements specified herein.
3. Forms shall be constructed so they can be removed without hammering on or prying against concrete, and without damaging concrete in any way.
4. Verify that forms are clean before applying release agent.
5. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.
6. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer’s instructions.
7. In locations where new concrete is doweled to existing Work, drill holes in existing concrete, clean holes of dust and debris, fill holes with epoxy bonding agent, and insert steel dowels.
8. The District Engineer’s review of formwork will not relieve the Contractor from any responsibility as to the adequacy of the formwork, shoring and bracing design. All formwork installed by the Contractor shall be solely at his risk. The District Engineer’s review will not lessen or diminish the Contractor’s liability.

R. Alignment and Tolerances. Formwork shall be designed and constructed so that concrete surfaces of finished structures will comply with the tolerances specified in ACI 347; and will conform to the following:

1. Vertical Alignment shall have a maximum allowable variation, from bottom to top of a wall, is plus or minus 3/8 inch.
2. Plumb maximum allowable variations are as follows:
 - a. In plumb and surfaces of columns and walls is plus or minus ¼ inch in any 10 feet of length; and a maximum of one inch for entire length.
 - b. In plumb for exposed corner, control-joint grooves, or other conspicuous lines is plus or minus ¼ inch in any 20 feet of length; and a maximum of ½ inch for the entire length.
 - c. Wall thickness: shall not vary more than minus 1/8 inch or plus ½ inch.
 - d. Level or Grade: maximum variation from level or grade indicated shall not exceed plus or minus ¼ inch in any 10-feet of length; or plus or minus 3/8 inch in any 20 feet of length.
 - e. Distance: maximum variation in distance between walls, columns, or other members shall not exceed plus or minus ¼ inch in any 10 feet of length; and not more than one-inch total variation.

S. Placing Concrete

1. Place concrete in accordance with ACI 304R.
2. Place concrete for floor slabs in accordance with ACI 302 1R.

3. Notify the District Inspector not less than 24 hours prior to commencement of placement operations. No concrete shall be placed until all formwork, construction joints, reinforcing steel, and other items have been completed and accepted by the District Inspector.
4. Before placing concrete, inspect and complete formwork installations, reinforcing steel placement, and items to be embedded or cast-in.
5. Notify other crafts involved in ample time to permit installation of their work: cooperate with other trades in setting such work.
6. All dirt, chips, sawdust, debris, mud, water and other foreign matter shall be removed from within forms or within excavated areas adjacent to forms before any concrete is placed.
7. Ensure reinforcement, inserts, waters-tops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
8. Separate slabs on grade from vertical surfaces with ¼ inch thick joint filler.
9. Install joint devices in accordance with manufacturer's instructions.
10. Concrete shall be conveyed from mixer to forms as rapidly as possible with specified time limits; and by methods that will prevent segregation of concrete mix.
11. The concrete shall be placed within 15 minutes after it has been discharged from mixer.
12. Provide adequate equipment and labor for conveying concrete to ensure a continuous flow of concrete at delivery point.
13. Concrete shall be deposited as close as possible to its final position in the forms; there shall be no vertical drop greater than 8 feet, except where suitable equipment is provided to prevent segregation of concrete and where specifically authorized.
14. Deposit concrete so that it will be defectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in single layer.
15. Where placement consists of several layers, place each layer while the preceding layer is still plastic to avoid cold joints, and within 30 minutes after placement of preceding layer.
16. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
17. Place concrete continuously between predetermined expansion, control, and construction joints.
18. Do not interrupt successive placement; do not permit cold joints to occur.
19. Do not use concrete which becomes non-plastic or unworkable, does not meet the required quality control limits, or which has become contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the Project site and dispose of it in an acceptable manner.
20. Place floor slabs in checkerboard or saw cut pattern indicated.
21. Saw cut joints within 24 hours after placing. Use 3/16-inch-thick blade, cut into ¼ depth of slab thickness.
22. Screed floors and slabs on grade level, maintaining surface flatness of maximum variation of ¼ inch in 10 feet.
23. Concrete shall not be placed in water, nor shall water be allowed to rise over freshly placed concrete until the concrete has set sufficiently to prevent its being damaged thereby.

T. Consolidating

1. Consolidate each layer of concrete immediately after placement with internal vibrators in accordance with ACI 309, except for slabs 4 inches thick or less.

2. Vibrators shall be inserted vertically at uniform spacing over entire area of placement, spacing to be approximately 1-1/2 times radius of action of vibrator. Vibrators shall penetrate rapidly to bottom of layer being placed, and at least 6 inches into the preceding layer.
3. Vibrators shall be supplemented by hand spading adjacent to forms on exposed surfaces. Concrete shall be compacted and well worked into all corners and angles in forms, and around reinforcement and embedded items.

U. Concrete Finishing

1. Repair and patch surface defects, including tie holes, on all surfaces immediately after removing formwork.
2. Unexposed Form Finish: Rub down or chip off fins or other raised areas ¼ inch or more in height.
3. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas ¼ inch or more in height. Provide finish as follows.
4. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
5. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with a clean burlap, and keep moist for 36 hours.

V. Concrete Slabs: Finish to requirements of ACI 301, 1R, and as follows:

1. Wood float surfaces that will receive trowel finish or other finishes, as indicated.
2. Steel trowel surfaces that will be left exposed.
3. Broom finish exterior concrete to provide a non-slip finish.
4. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal.
5. All exposed edges to be chamfered; ¾ inches minimum.

W. Curing and Protection

1. Comply with the requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
3. Normal concrete: Not less than 7 days.
4. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
5. Surfaces Not in Contact with Forms:
6. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-fog spray, or saturated burlap, as acceptable to the District Engineer.
7. Begin final curing after initial curing but before surface is dry.
8. Moisture retaining cover: Seal in place with waterproof tape or adhesive.
9. Curing compound: Apply in two coats at right angle, using application rate recommended by manufacturer.

X. Field Quality Control

1. An independent testing agency will perform field quality control tests, as specified.
2. Provide free access to concrete operations at Project site and cooperate with appointed firm.
3. Submit proposed mix design to the District Engineer and testing firm for review prior to commencement of concrete operations.

4. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
5. Compressive Strength Tests: ASTM C39. For each test, make and cure three concrete test cylinders. Obtain test samples for every 50 cubic yards or less of concrete placed each day.
6. Take two additional test cylinders during cold weather concreting, cured on job site under same conditions as concrete it represents.
7. Perform one slump test for each load at point of discharge; and perform slump test with each set of test cylinders taken.
8. If maximum slump for the application is exceeded, it will be assumed that the water content is excessive, and the load shall be rejected.
9. If the slump is less than the minimum for the application, a measured quantity of water may be added to the mix; quantity shall not exceed 1/6 gallon of water per bag of cement.
10. Water shall be added only in the presence of the District Inspector and after a slump test has been made.
11. If concrete has been mixed for more than one hour, the loss of slump shall be considered as being caused by setting of the concrete; water shall not be added, and the load shall be rejected.
12. Perform test to determine air content in accordance with ASTM C231; a minimum of one test shall be done each time a slump test is made. Air content shall be within specified limits.

Y. Defective Concrete

1. Test Results: The testing agency shall report test results in writing to the District Inspector and Contractor within 24 hours of the test.
2. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
3. The District Inspector will determine repair or replacement of defective concrete. The cost of additional testing shall be borne by the Contractor when defective concrete is identified.
4. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the District Inspector for each individual area.

Z. Schedule – Concrete Types and Finishes

1. Structure not exposed to View: 4,000 psi at 28-day concrete cure; form finish surface, with honeycomb and holes filled and repaired.
2. Exposed Structures: 4,000 psi at 28-day concrete cure; air entrained, smooth rubbed finish

SECTION 6

**STANDARD
DRAWINGS**

