SECTION 6

SANITARY SEWER

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6. SANITARY SEWER STANDARDS

6.01 General

The standards established by this chapter are intended to represent the minimum standards for the design and construction of sanitary sewer facilities. Greater or lesser requirements may be mandated by the City due to localized conditions. Washington State Department of Ecology's Design Standards shall also be employed by the City in its review and approval of system connections, extensions, and/or modifications.

"Off-site" improvements may be warranted based on (1) the existing condition and capacity of the existing sanitary infrastructure and, (2) impacts caused by the proposed development. These off-site improvements in addition to "on-site" improvements as may be warranted will be as determined by the City Engineer so as to reasonably mitigate impacts caused by development.

The following design and construction considerations shall apply:

6.02 Design Standards

The design of sanitary sewer systems shall be dependent on local site conditions. The design elements of sanitary sewer systems shall conform to minimum City Standards set forth herein and follow current design practice as further set forth in Section 6.01 through 6.17.

A. Detailed plans shall be submitted for the City's review which provide the location, size, type and direction of flow of the proposed sewers and the connection with existing sewers. These plans shall be separate from water plans.

B. Project plans should have a horizontal scale of not more than 50 feet to the inch and a vertical scale of not more than 5 feet to the inch. Plan views shall be drawn to a corresponding horizontal scale. Plans and profiles shall show:

Locations of streets, right-of-ways, existing utilities, and sewers.

Ground surface, pipe type, class and size, manhole stationing, invert and surface elevation at each manhole, and grade of sewer between adjacent manholes. All manholes shall be numbered on the plans and correspondingly numbered on the profile. Where there is any question of the sewer being sufficiently deep to serve any residence, the elevation and location of the basement floor, if basements are served, shall be plotted on the profile of the sewer which is to serve the house in question. The Developer shall state that all sewers are sufficiently deep to serve adjacent basements, except where otherwise noted on the plans.

All known existing structures, both above and below ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, overhead and underground power lines, telephones lines, and television cables.

All utility easements, including County recording numbers.

Details in scale drawings which clearly show special sewer joints and cross-sections, and sewer appurtenances such as manholes and related items and all other items as required by the City to clearly identify construction items, materials, and/or methods.

C. Construction of new sewer systems or extensions of existing systems will be allowed only if the existing receiving system is capable of supporting the added hydraulic load. Sewers shall be extended to the far property line(s) to facilitate future extensions of same.

D. Collection and interceptor sewers shall be designed and constructed for the ultimate development of the tributary areas.

E. Sewer systems shall be designed and constructed to achieve total containment of sanitary wastes and maximum exclusion of infiltration and inflow.

F. Computations and other data used for design of the sewer system shall be submitted to the City for approval.

G. The sewage facilities shall be constructed in conformance with the 1998, Standard Specifications for Road, Bridge, & Municipal Construction, and current amendments thereto, State of Washington, revised as to form to make reference to Local Governments, and as modified by any special City requirements and standards.

H. Material and installation specifications shall contain appropriate requirements that have been established by the industry in its technical publications, such as ASTM, AWWA, WPCF, UPC and APWA standards. Requirements shall be set forth in the specifications for the pipe and methods of bedding and backfilling so as not to damage the pipe or its joints, impede cleaning operations and future tapping, nor create excessive side fill pressure or ovulation of the pipe, nor seriously impair flow capacity.

I. All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer because of the width and depth of trench should be made. When standard-strength sewer pipe is not sufficient, extra-strength pipe shall be used.

J. All pipe shall be laid in straight lines and at uniform rate of grade between manholes. Variance from established line and grade shall not be greater than one-half inch (1/2"), provided that such variation does not result in a level of reverse sloping invert; provided, also, that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth inch (1/64") per inch of pipe diameter, or one-half inch (1/2") maximum.

Any corrections required in line and grade shall be reviewed with the City and/or the City Engineer and shall be made at the expense of the Developer and/or Contractor.

K. Deflection tests shall be performed on all PVC sewer mains and the deflection test limit shall be 5.0 percent of the base inside diameter of the pipe.

L. Prior to final inspection, all pipelines shall be tested, flushed and cleaned and all debris removed. A pipeline "cleaning ball" of the proper diameter for each size of pipe shall be flushed through all pipelines prior to final inspection. Hydrant meters shall be acquired (deposit required) from the City and utilized by the Contractor for all water withdrawn from the City of Long Beach's system for flushing purposes.

M. Before sewer lines are accepted, the Contractor/Developer shall perform a complete televised inspection of the sewer pipe and appurtenances and shall provide to the City an audio-visual tape recording of these inspections. All equipment and materials shall be compatible with existing City equipment. It shall be the Contractor/Developer's responsibility to confirm equipment compatibility with the City prior to inspection.

N. At all times during the televised inspection process, the City's Utility Superintendent and/or his designated representative shall be present. The City's Utility Superintendent shall be notified forty-eight (48) hours prior to any televised inspection.

O. After all other work is completed and before final acceptance, the entire roadway, including the roadbed, planting, sidewalk areas, shoulders, driveways, alley and side street approaches, slopes, ditches, utility trenches, and construction areas shall be neatly finished to the lines, grades and cross sections for a new roadway consistent with the original section.

P. The Developer shall be required, upon completion of the work and prior to acceptance by the City, to furnish the City with a written guarantee covering all material and workmanship for a period of two years after the date of final acceptance and the Developer shall make all necessary repairs during that period at his own expense, if such repairs are necessitated as the result of furnishing poor materials and/or workmanship. The Developer shall obtain warranties from the contractors, subcontractors and suppliers of material or equipment where such warranties are required, and shall deliver copies to the City upon completion of the work.

6.03 General Requirements

1. Prior to construction, the sewer plans shall be reviewed and approved by the Department of Ecology (if required by the City) and an affidavit stating such shall be on file at the City's Public Works Department.

2. Prior to construction, the Contractor shall notify the City for a pre-construction meeting.

3. Work shall be performed only by licensed and bonded contractors with a demonstrated experienced in laying public sewer mains of the type being proposed for construction.

4. Prior to any work being performed, the Contractor shall contact the Public Works Superintendent or City Administrator to set forth his proposed schedule.

5. Contractor shall obtain approval of materials to be used from the City prior to ordering or delivery of materials.

6. Sewer main shall be laid only in dedicated streets or in easements which have been exclusively granted to the City. A street is normally not officially recognized until the plat which created it has been filed (recorded) with the County Auditor.

7. The sewer main shall run parallel to and 5 feet southerly or westerly of street centerline where possible. The sewer main shall maintain a minimum 10 foot horizontal separation from proposed or existing water mains.

8. The maximum distance between manholes shall be 400 feet unless specifically approved otherwise by the City Engineer.

9. PVC pipe shall be a minimum Class S.D.R. 35 and be manufactured in accordance with ASTM D3034 or, ASTM F 789 with joints and rubber gaskets conforming to ASTM D3212 and ASTM F477. Ductile iron pipe shall be as classified by the City and conform to AWWA C151 and C104.

10. The allowable cover (finished grade) for the various types of pipe are:

PVC Pipe:	3' to 25'
Pipe:	<3' (if allowed)
	25' & above
	Slopes of 18 percent or greater

All pipe shall have a minimum of thirty six (36) inches of cover (18" in the case of a side sewer on private property). The City reserves the right to require a minimum of three feet of cover unless topography, existing facilities or other future improvements prohibit this minimum cover for installation.

11. The minimum slope for 8" gravity mains shall be 0.5% (except the minimum slope for dead end runs shall be 1.0% for 8" gravity mains) and the minimum slope for 6" side sewer laterals shall be 2.0%.

12. All side sewer laterals shall be of the same material as the main line.

13. Each side sewer lateral shall be equipped with a 6" x 6" inspection tee, with an approved water-tight cap, located adjacent to, but within, the public right-of-way, to be utilized as a clean-out. When required by the City's Utilities Superintendent and/or City Engineer, a watertight six-inch capped stub shall be installed which extends vertically from the 6" x 6" tee to within 18 inches of finished grade. See detail.

14. Each side sewer lateral shall have an approved water-tight cap at the termination of the stub, it shall be adequately "blocked" to satisfactorily resist the air pressure testing.

15. Each side sewer lateral shall have a twelve (12) foot long 2" x 4" wood "marker" at the termination of the stub. The "marker" shall extend from the bottom of the trench to above finished grade. Above the ground surface, it shall be painted "white" with "S/S" and the depth, in feet, stenciled in black letters 2" high.

16. Front lot corners shall be staked prior to construction for side sewer tee location.

17. All side sewers shall be extended to the lowest property corner and located a minimum of 10 feet from the side lot line and extend a minimum of 10 feet past the street right-of-way line (or property line).

18. Side sewer connections if allowed directly into manholes shall be constructed to match the sewer main crown (outlet) and the manhole channeled accordingly.

19. Manholes, where sewer extension may occur, shall be provided with knock-outs and channeled accordingly.

20. Manholes shall be provided with a 0.10 foot drop across the channel.

21. Locking lids shall be provided for all manholes located outside pavement areas and in easements. All manhole lids shall have the word "sewer" cast integrally into its surface.

22. Concrete collars shall be placed around all frames per the Standard Detail for manholes, both in and out of pavement areas.

23. Pipe connections to manholes shall be as follows:

    PVC Pipe: Cast or grout a watertight manhole coupling (see detail) into manhole wall.

    Pipe: Bell and spigot joint or flexible coupling, either shall be 12" maximum distance from manhole wall.

    PVC and D.I. pipe, optional: Core the manhole and connect sewer pipe with a water-tight flexible rubber boot in manhole wall, Kor-N-Seal boot, Heavy Duty sand collar or owner approved equal.

24. Provide the City's Engineer and City Sewer Superintendent a copy of the cut sheets prior to construction.

25. Pipe trenches shall not be backfilled until pipe and bedding installation has been inspected and approved by the City's Inspector.

26. Final air testing shall not be accepted until after the asphalt treated base or finished paving is accomplished, all other underground utilities have been installed, and the lines have been flushed, cleaned, deflection tested and television inspected.

27. Manhole rim and invert elevations shall be field verified after construction by the Developer's engineer(s) and the "as constructed" drawings individually stamped by a Washington State licensed professional engineer which shall attest to the fact that the information is correct.

6.04 Materials and Testing

A. Sewer Mains, Laterals And Force Mains

Sewer mains to be installed shall be of material noted below:

Gravity Sewer and Laterals:

PVC Pipe:	3'-25' Cover
DI Pipe:	<3' Cover (if allowed)
	25' and Over
	Slopes of 18 percent or greater

Force Main:

DI Pipe Class 52 or PVC C-900 (per City's direction)

Gravity PVC sewer pipe (12" and less diameter) shall be a minimum Class S.D.R. 35 and be manufactured in accordance with ASTM D3034. Gravity sewer PVC pipe (18" diameter and greater) shall be ASTM F679. Joints and gaskets shall conform to ASTM D3212 and ASTM F477. The pipe and fittings shall be furnished with bells and spigots which are integral with the pipe wall. Nominal laying lengths shall be 20 feet and 13 feet.

The ductile iron pipe shall conform to ANSI/AWWA C151/A21.51-91 Standards, and current amendments thereto, except the ductile iron pipe shall be thickness of Class mandated by the City Engineer for gravity sewers and Class 52 for force mains. Grade of iron shall be a minimum of 60-42-10. The pipe shall be cement lined to a minimum thickness of 1/16", and the exterior shall be coated with an asphaltic coating. Each length shall be plainly marked with the manufacturer's identification, year case, thickness, class of pipe and weight.

Type of joint shall be mechanical joint or push-on type, employing a single gasket, such as "Tyton", except where otherwise calling for flanged ends. Bolts furnished for mechanical joint pipe and fittings shall be high strength ductile iron, with a minimum tensile strength of 50,000 psi.

Restrained joint pipe, where required shall be push-on joint pipe with "Fast Tight" gaskets as furnished by U.S. Pipe or equal for 12" diameter and smaller pipe and "TR FLEX" as furnished by U.S. Pipe or equal for 16" and 24" diameter pipes. Mechanical joint pipe with retainer glands (grip rings) as manufactured by "Romac" may also be required at the discretion of the City. The restrained joint pipe shall meet all other requirements of the non-restrained pipe.

All pipe shall be jointed by the manufacturer's standard coupling, be all of one manufacturer, be carefully installed in complete compliance with the manufacturer's recommendations.

All fittings shall be short-bodied, ductile iron complying with applicable ANSI/AWWA C110 or C153 Standards for 350 psi pressure rating for mechanical joint fittings and 250 psi pressure rating for flanged fittings. All fittings shall be cement lined and either mechanical joint or flanged, as indicated on the Plans.

Fittings in areas shown on the Plans for restrained joints shall be mechanical joint fittings with a mechanical joint restraint device. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG, or ROMAC "Grip Ring", as required and approved by the City Engineer.

All couplings shall be ductile iron mechanical joint sleeves.

The sewer pipe, unless otherwise approved by the Public Works Director and/or City Engineer, shall be laid upgrade from point of connection on the existing sewer or from a designated starting point. The sewer pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with an approved temporary plug. Wherever movable shoring (steel box) is used in the ditch, pipe shall be restrained by use of a winch mounted in the downstream manhole and a line of sufficient strength threaded through the pipe and set tight before each move. Any indication that joints are not being held shall be sufficient reason for the City to require restraints, whether or not movable shoring is being used.

All pipe shall be laid in straight lines and at uniform rate of grade between manholes. Variance from established line and grade shall not be greater than one-half inch (1/2"), provided that such variation does not result in a level of reverse sloping invert; provided, also, that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth inch (1/64") per inch of pipe diameter, or one-half inch (1/2") maximum. Any corrections required in line and grade shall be reviewed with the City Utilities Superintendent and/or City Engineer and shall be made at the expense of the Developer.

All extensions, additions and revisions to the sewer system, unless otherwise indicated, shall be made with sewer pipe jointed by means of a flexible gasket which shall be fabricated and installed in accordance with the manufacturer's specifications.

All joints shall be made up in strict compliance with the manufacturer's recommendations and all sewer pipe manufacture and handling shall meet or exceed the ASTM and CPAW recommended specifications, current revisions.

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or loading it with dirt or other foreign material. Any gaskets so disturbed shall be removed, cleaned, relubricated if required, and replaced before the rejoining is attempted.
Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling or crane to minimize unequal lateral pressure on the

gasket and to maintain concentricity until the gasket is properly positioned. Since most flexible gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to assure that it is home, as described in the installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied to the line to assure that joints once home are held so, until fill material under and alongside the pipe has been sufficiently compacted. At the end of the work day, the last pipe laid shall be blocked in an effective way to prevent creep during "down time."

For the joining of dissimilar pipes suitable adapter couplings shall be used which have been approved by the City Inspector and/or the Engineer.

All gravity sewer pipe shall be bedded with pea gravel. The PVC pipe shall be bedded from a depth of four (4) inches below the pipe to eight (8) inches above the pipe and ductile iron gravity sewer pipe shall be bedded from a depth of four (4) inches below the pipe to the springline of the pipe. The bedding material shall extend across the full width of the trench and shall be compacted under the haunches of the pipe.

Special concrete bedding shall consist of a pipe cradle constructed of Portland cement concrete containing not less than four (4) sacks of cement per cubic yard. Sand, gravel and water proportions are subject to approval by the Engineer. Maximum aggregate size shall be 1-1/2". Maximum slump shall be 4". The bottom of the trench shall be fully compacted before the placement of pipe cradle. The Contractor shall protect pipe against flotation and disturbing the horizontal alignment of the pipe during the pouring of the concrete. (Washington State Department of Transportation Standard Specifications for "Class A" concrete bedding will be acceptable.)

Clay or Bentonite dams shall be installed across the trench and to the full depth of the granular material in all areas of steep slopes, stream crossings and wetland to prevent migration of water along the pipeline.

All backfill shall be placed and compacted in accordance with City, County, or State requirements as may be applicable and copies of the compaction results shall be provided to the City Engineer.

B. Manholes

Manholes shall be of the offset type and shall be precast concrete sections with either a cast in place base, or a precast base made from a 3,000 psi structural concrete. Joints between precast wall sections shall be confined O-ring or as otherwise specified.

For connections to existing systems, a concrete coring machine, suitable for this type of work, shall be utilized in making the connection. The existing manhole shall be rechanneled as required. The new pipe connection shall be plugged (water tight) until the new pipe system has been installed and approved. The Contractor shall be responsible for any existing defects in the existing manhole unless these defects are witnessed by a representative of the City prior to any work being performed to make the connection. The Contractor shall be required

to remove any and all deleterious material in the existing manhole and downstream reaches as a result of his/her work.

1) Manhole Sections

Manhole sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder steps. The completed manhole shall be rigid, true to dimension, and be water tight. Rough, uneven surfaces will not be permitted.

The mortar used between the joints in the precast sections and for laying manhole adjusting bricks shall be composed of one part cement to two parts of plaster sand. All joints shall be thoroughly wetted and completely filled with mortar, smoothed both inside and outside to insure water tightness.

Masonry units (manhole adjusting brick) shall conform to the ASTM C-32, Grade MA. The outside and inside of manhole adjusting bricks and the joints of precast concrete sections shall be plastered and troweled smooth with 1/2" (minimum) of mortar in order to attain a watertight surface.

2) Manhole Steps

Manhole steps shall be polypropylene, Lane International Corp. No. P13938 or equal. Ladders (maximum 3 foot length) shall be polypropylene Lane International Corp. or equal, and shall be compatible with steps.

3) Grade Adjustment

Where work is located in public right of way, not less than 18" or more than 26" shall be provided between the top of the cone or slab and the top of the manhole frame.

4) Channels

Channels shall be made to conform accurately to the sewer grade and shall be brought together smoothly with well rounded junctions, satisfactory to the City Utilities (Sewer) Superintendent. The channels shall be field poured after the inlet and outlet pipes have been laid and firmly grouted into place at the proper elevation. Allowances shall be made for a one-tenth foot (0.1') drop in elevation across the manhole in the direction of flow. Channel sides shall be carried up vertically from the invert to three-quarters of the diameter of the various pipes. The concrete shelf shall be warped evenly and sloped 3/8" per foot to drain. Rough, uneven surfaces will not be permitted. Channels shall be constructed to allow the installation and use of a mechanical plug or flow meter of the appropriate size.

5) Drop Manholes

Drop manholes shall, in all respects, be constructed as a standard manhole with the exception of the drop connection as further detailed herein.

6) Lift Holes and Steel Loops

All lift holes shall be completely filled with expanding mortar, smoothed both inside and outside, to insure water tightness. All steel loops shall be removed, flush with the manhole wall. The stubs shall be covered with mortar and smoothed. Rough, uneven surfaces will not be permitted.

7) Frames and Covers:

Frames and covers shall be ductile iron. Castings shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar material, will not be permitted. Frames and covers shall be machine finished or ground on seating surfaces so as to assure non-rocking fit in any position and interchangeability of covers. Frames and covers shall be provided with three bolt locking lids. Rings and covers shall be positioned so one of the three locking bolts is located over the manhole steps and shall be adjusted to conform to the final finished surface grade of the street or easement to the satisfaction of the City or agent for the City. Manhole frames and covers shall be as manufactured by "Sather" Manufacturing Company, Model No. 6024-R, or City approved equal.

C. Side Sewer Lateral

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

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

Side sewers shall be for a single connection only and be a minimum six inch (6") diameter pipe. Side sewers shall be connected to the tee, provided in the sewer main where such is available, utilizing approved fittings or adapters. The side sewer shall rise at a maximum of 45° and a minimum of 2%, from the sewer main.

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

The Contractor shall provide for each 6 inch side sewer service a twelve (12) foot long 2 inch x 4 inch wooden post which extends from the invert of the end of the 6 inch pipe to above the existing ground. The exposed area of this post shall be painted white and shall have selected thereon in two inch letters (black paint) "S/S" and shall also indicate the depth of the sewer service stub from finished grade.

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

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

D. Private Side Sewers

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

1. Side sewer pipe located on private property shall be 4" (larger if specifically approved by the City), ductile iron or PVC ASTM 3034, and shall be installed at 2% minimum grade (1/4 inch fall per foot). Construction on private property may be performed by owner, but requires a permit.

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

3. Six inch sewer pipe is required in the street right-of-way and shall have a 2% minimum grade. Construction in street rights-of-way shall be performed by a licensed side sewer contractor and requires a permit.

4. Side sewer shall be inspected by the City's inspector prior to backfilling. Side sewers shall be plugged and tested in the presence of the City inspector. Testing shall be by air testing or by exfiltration testing (i.e., filling the pipe with water). Leakage rate shall not exceed 0.31 gal./hr. for 4 inch pipe and 0.47 gal./hr. for 6 inch pipe, per 100 feet of pipe.

5. On private property, minimum cover shall be 18" over top of pipe from a point which is located 30" out from the structure and continuing to the right-of-way or easement line.

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

7. No more than 100 feet is allowed between cleanouts. Cleanouts are required for bends equal to or greater than 45°. Cleanout shall be a watertight plugged gasketed tee or wye lateral.

8. All pipe joints shall be rubber gasket type.

9. Furnish and install "grease trap" of a size and type approved by the City at all such locations as may be deemed necessary by the City. Calculations for sizing shall be provided for the City's review and approval when requested.

E. Testing Gravity Sewers For Acceptance

The Contractor and/or Developer shall furnish all facilities and personnel for conducting tests under the observation of the City Engineer or City Inspector. Methods other than Part "B" shall be subject to the approval of the Public Works Director and/or City Engineer.

1. Preparation for Testing for Leakage

The Contractor and/or Developer shall be required, prior to testing, to clean and flush all gravity sewer lines with an approved cleaning ball and clean water. The completed gravity sewer, including side sewer stubs, after completion of backfill and cleaning shall be televised inspected. This will be permitted prior to paving. The sewer shall then be tested by the low pressure air test method and/or an infiltration test but only after all utilities are installed and the project paved. Except, however, that in certain conditions an exfiltration test may be required by the City Utilities Superintendent and/or City Engineer.

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

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

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

2. Low Pressure Air Test

The sewer pipe shall be tested for leaks through the use of air (unless method "C" and "D" are approved) in the following manner:

Immediately following the pipe cleaning and televised inspection, the pipe installation shall be tested with low pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

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

The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 pounds per square inch greater than the pipe section's adjacent groundwater back pressure if the total rate of air loss from any section tested in its entirety between manholes, cleanouts or pipe ends does not exceed the following table:

Length of 6" Pipe (ft)

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

Test time in minutes and seconds

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

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

Plugs used to close the sewer pipe for the air test shall be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gauges, air piping manifolds and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Air testing apparatus shall be equipped with a pressure release device such as a rupture disk or a pressure relief valve designed to relieve pressure on the pipe under test at 6 psi.

3. Exfiltration Test (if approved by City)

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

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

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

4. Infiltration Test (if approved by City)

Infiltration testing shall take place during jetting of backfill, except when the natural groundwater table is above the crown of the higher end of the test section. The maximum allowable limit for infiltration shall be 0.15 gallon per hour per inch of internal diameter per 100 feet of length with no allowance for external hydrostatic head.

5. Deflection Test

Deflection tests shall be performed on all PVC gravity sewer mains by pulling a mandrel through the pipe and the deflection test limit shall be 5.0 percent of the base inside diameter or for example 7.28 inches for 8-inch diameter pipe. The sewer lines shall be thoroughly cleaned prior to the deflection test.

F. Testing Force Main

1. Test Specifications

All force mains shall be tested prior to acceptance of work. All pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring equipment necessary for performing the test shall be furnished, installed and operated by the Contractor. Feed for the pump shall be from a barrel or other container within the actual amount of

"makeup" water, so that it can be measured periodically during the test period.

The pipeline shall be backfilled sufficiently to prevent movement of the pipe under pressure. All thrust blocks shall be in place and time allowed for the concrete to cure before testing. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking.

The pipeline shall be subjected to a pressure and leakage test of a minimum of 150 pounds per square inch for a period of not less than one (1) hour. The test pressure shall be applied at the low end of the section tested.

The quantity of water lost from the main shall not exceed the number of gallons per hour determined by the formula:

$$L = \frac{ND(P)^{0.5}}{7,400}$$

in which

L = Allowable leakage, gallons/hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, psi

Defective materials or workmanship, discovered as a result of the tests, shall be replaced by the Contractor at the Contractor's expense. Whenever it is necessary to replace defective material or correct the workmanship, the tests shall be re-run at the Contractor's expense until a satisfactory test is obtained.

2. Preliminary Tests

Developer and/or Contractor shall conduct preliminary tests and assure himself that the section to be tested is in an acceptable condition before requesting the City Inspector and/or City Engineer to witness the test.

3. Thrust Blocks and Anchor Blocks

All fittings shall be blocked with concrete in order to prevent movement and separation of pipe joints. Timber will not be permitted as permanent blocking. Sufficient time shall be allowed for concrete to set before commencement of pressure tests. The type and size of blocks and anchors shall be as detailed herein. A visqueen barrier shall be provided to protect glands, bolts, and other miscellaneous materials required for this type of connection from the concrete.

6.05 Video Taping

Upon completion, the sewer lines shall be internally televised by a qualified firm providing said services. A 1/2 inch VHS tape together with a written log of the television inspection shall be submitted to the City for their review and approval, and if accepted, be retained in their files. This

work can be performed prior to paving. The City's inspector shall be notified of the date of TV inspection to insure his availability and on-site witnessing of the event during this time.

6.06 State Highway and Stream/Creek Crossings

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

6.07 Staking

All surveying and staking shall be performed by an engineering or surveying firm employed by the Developer and capable of performing such work. The engineer or surveyor directing or performing such work shall be currently licensed by the State of Washington to perform said tasks.

A preconstruction meeting shall be held with the City prior to commencing staking. All construction staking shall be inspected by the City prior to construction.

The minimum staking of sanitary sewer systems shall be as follows:

A. Stake centerline alignment at a minimum of fifty foot intervals unless otherwise approved by the City.

B. Stake location of all manholes and side sewer laterals for grade and alignment.

C. Provide a copy of "cut sheets" to City inspector.

D. Stake finished manhole rim elevation and invert elevations of all pipes in manholes.

6.08 Trench Excavation

A. Clearing and grubbing where required shall be performed within the easement or public right-of-way as permitted by the City and/or governing agencies. Debris resulting from the clearing and grubbing shall be disposed of by the owner or contractor in accordance with the terms of all applicable permits.

B. Trenches shall be excavated to the line and depth designated by the City to provide a City approved minimum of cover over the pipe. See Details as applicable. Except for unusual circumstances where approved by the City, the trench sides shall be excavated vertically

and the trench width shall be excavated only to such widths as are necessary for adequate working space as allowed by the governing agency and in compliance with all safety requirements of the prevailing agencies. See Detail. The trench shall be kept free from water until joining is complete. Surface water shall be diverted so as not to enter the trench. The owner shall maintain sufficient pumping equipment on the job to insure that these provisions are carried out.

C. The contractor shall perform all excavation of every description and whatever substance encountered and boulders, rocks, roots and other obstructions shall be entirely removed or cut out to the width of the trench and to a depth 6 inches below sewer line grade. Where materials are removed from below pipe grade, the trench shall be backfilled to grade with material satisfactory to the City and thoroughly compacted.

D. Trenching and shoring operations shall not proceed more than 100 feet in advance of pipe laying without approval of the City, and shall be in conformance with Washington Industrial Safety and Health Administration (WISHA) and Office of Safety and Health Administration (OSHA) Safety Standard. Neither the City nor its agents shall be relied upon as safety experts. The City is not responsible for insuring safety on the site. It shall be the developers and his agents sole responsibility to insure adequate safety provisions are provided at all times.

E. The bedding course shall be constructed to grade with hand tools in such a manner that the pipe will have bearing along the entire length of the barrel. The bell holes shall be excavated with hand tools to sufficient size to make up the joint.

6.09 Bedding

Gravel backfill for pipe bedding shall be installed in conformance with Section 2-09 of the Standard Specifications (WSDOT). See Detail.

Bedding for Rigid Pipe (Ductile Iron Pipe):

Gravel backfill for rigid pipe bedding shall consist of crushed, processed, or naturally occurring granular material. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following specifications for grading and quality:

Sieve Size	Percent Passing*	
3/4" Square	100	
3/8" Square	95-100	
U.S. No. 8	0-10	
U.S. No. 200	0-3	
Sand Equivalent	35	MIN.

*All percentages are by weight.

Bedding for Flexible Pipe (P.V.C. pipe):

Gravel backfill for flexible pipe (P.V.C. pipe) bedding shall consist of crushed, processed, or naturally occurring granular material. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following specifications for grading and quality:

Sieve Size	Percent Passing*	
3/4" Square	100	
3/8" Square	95-100	
U.S. No. 8	0-10	
U.S. No. 200	0-3	
Sand Equivalent	35	MIN.

*All percentages are by weight.

Native Material shall not be used for bedding, unless approved by the Engineer.

6.10 Backfilling

Backfilling and surface restoration shall closely follow installation of pipe so that not more than 100 feet is left exposed during construction hours without approval of the City. Selected backfill material shall be placed and compacted around and under the sewer pipe by hand tools. Special precautions shall be provided to protect the pipe to a point 12 inches above the crown of the pipe. The remaining backfill shall be compacted to 95 percent of the maximum density in traveled areas and road "prisms", 90 percent outside driveway, roadways, road prism, shoulders, parking or other traveled areas. Where governmental agencies other than the City have jurisdiction over roadways, the backfill and compaction shall be done to the satisfaction of the agency having jurisdiction. Typically, all utility trenches located in roadway sections, roadway "prisms", or beneath traffic bearing areas shall be backfilled with 5/8-inch minus crushed rock. Due to localized conditions, the City may allow/permit the backfill of the trench section with suitable excavated material, as determined by the City, or if suitable native material is not available from trenching operations, the City may order the placing and compaction of gravel base conforming with Section 9-03.10 of the Standard Specifications (WSDOT) for backfilling the trench. All excess material shall be loaded and hauled to waste.

6.11 Street Patching and Restoration

See Chapter 4B.16 and 4B.17 for requirements regarding street patching and trench restoration.

6.12 Erosion Control

The detrimental effects of erosion and sedimentation shall be minimized by conforming with the following general principles:

A. Soil shall be exposed for the shortest possible time.
B. Reducing the velocity and controlling the flow of runoff.
C. Detaining runoff on the site to trap sediment.
D. Releasing runoff safely to downstream areas.

In applying these principles, the Developer and/or Contractor shall provide for erosion control by conducting work in workable units; minimizing the disturbance to cover crop materials; providing mulch and/or temporary cover crops, sedimentation basins, and/or diversions in critical areas during construction; controlling and conveying runoff; and establishing permanent vegetation and installing erosion control structures as soon as possible.

1. Trench Mulching

Where there is danger of backfill material being washed away due to steepness of the slope along the direction of the trench, backfill material shall be compacted and held in place by covering the disturbed area with straw and held with a covering of jute matting or wire mesh anchored in place.

2. Cover-Crop Seeding

A cover crop shall be sown in all areas excavated or disturbed during construction that were not paved, landscaped and/or seeded prior to construction. Areas landscaped and/or seeded prior to construction shall be restored to their original or superior condition.
Cover-crop seeding shall follow backfilling operations.

The Developer and/or Contractor shall be responsible for protecting all areas from erosion until the cover crop affords such protection. The cover crop shall be re-seeded if required and additional measures taken to provide protection from erosion until the cover crop is capable of providing protection.

During winter months, the Contractor may postpone seeding, if conditions are such that the seed will not germinate and grow. The Developer and/or Contractor will not, however, be relieved of the responsibility of protecting all areas until the cover crop has been sown and affords protection from erosion.

The cover crop shall be sown at a rate of 10 to 15 pounds of seed per acre using a hand or power operated mechanical seeder capable of providing a uniform distribution of seed.

6.13 Adjustment Of New And Existing Utility Structures To Grade

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

1. Asphalt Concrete Paving Projects

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

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

The asphalt concrete pavement shall be cut and removed to a neat circle, the diameter of which shall not exceed 48" or 14" from the outside diameter of the ductile iron frame, whichever is smaller. The ductile iron frame shall be brought up to desired grade, which shall conform to surrounding road surface.

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

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

As soon as the street is paved past each manhole, the asphalt concrete mat shall be scored around the location of the manhole, catch basin, meter boxes or valve box. After rolling has been completed and the mat has cooled, it shall be cut along the scored lines. The manholes, catch basins, meter boxes and valve boxes shall then be raised to finished pavement grade and the annular spaces filled with cement concrete to within 1-1/2 inches of the finished grade. The remaining 1-1/2 inches shall be filled with asphalt concrete Class B to give a smooth finished appearance. See detail in Project Plans.

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

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

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

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

2. Adjustment of Manholes in Easements

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

3. Adjustment of Valve Box Castings

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

6.14 Finishing And Cleanup

Before acceptance of sewer system construction, all pipes, manholes, catch basins, and other appurtenances shall be cleaned of all debris and foreign material. After all other work on this project is completed and before final acceptance, the entire roadway, including the roadbed, planting, sidewalk areas, shoulders, driveways, alley and side street approaches, slopes, ditches, utility trenches, and construction areas shall be neatly finished to the lines, grades and cross sections of a new roadway consistent with the original section, and as hereinafter specified.

On sewer construction where all or portions of the construction is in undeveloped areas, the entire area which has been disturbed by the construction shall be shaped so that upon completion the area will present a uniform appearance, blending into the contour of the adjacent properties. All other requirements outlined previously shall be met.

Slopes, sidewalk areas, planting areas and roadway shall be smoothed and finished to the required cross section and grade by means of a grading machine insofar as it is possible to do so without damaging existing improvements, trees

and shrubs. Machine dressing shall be supplemented by hand work to meet requirements outlined herein, to the satisfaction of the City Inspector and/or the City Engineer.

Upon completion of the cleaning and dressing, the project shall appear uniform in all respects. All graded areas shall be true to line and grade. Where the existing surface is below sidewalk and curb, the area shall be filled and dressed out to the walk. Wherever fill material is required in the planting area, the finished grade shall be elevated to allow for final settlement, but nevertheless, the raised surface shall present a uniform appearance.

All surface rocks in excess of four (4) inches in diameter which in the City's opinion pose a safety hazard shall be removed from the construction site and shall be disposed of the same as required for other waste material. In no instance shall rocks be thrown or discarded onto private property. Any vegetative overhang on slopes which in the City's opinion are unsightly, or pose a threat to the safety or welfare of the public, shall be trimmed, cut, removed, and wastehauled. The slopes shall then be dressed neatly so as to present a uniform, smooth, even, contoured, and stabilized surface.

All excavated material at the outer lateral limits of the project shall be removed entirely. Trash of all kinds resulting from clearing and grubbing or grading operations shall be removed (and wastehauled) and not placed in areas adjacent to the project. Where machine operations have broken down brush and trees beyond the lateral limits of the project, the Developer and/or Contractor shall remove and dispose of same and restore said disturbed areas at his own expense.

Drainage facilities such as inlets, catch basins, culverts, and open ditches shall be cleaned of all debris which is the result of the Developer and/or Contractor's operations.

All pavements and oil mat surfaces, whether new or old, shall be thoroughly cleaned. Existing improvements such as Portland cement concrete curbs, curb and gutters, walls, sidewalks, and other facilities which have been sprayed by the asphalt cement shall be cleaned to the satisfaction of the City Inspector and/or City Engineer.

Castings for manholes, valves, lamp holes, vaults and other similar installations which have been covered with the asphalt material shall be cleaned to the satisfaction of the City.

6.15 Final Acceptance

Prior to final inspection, all pipelines shall be flushed and cleaned and all debris removed. A pipeline "cleaning ball" of the proper diameter for each size of pipe shall be flushed through all pipelines prior to final inspection.

Before sewer lines are accepted, all lines shall be inspected for line and grade by checking each section between manholes for alignment. A full circle of light shall be seen by looking through the pipe at a light held in the manhole at the opposite end of the section of sewer line being inspected. Any corrections required in line and grade shall be made at the expense of the Developer and/or Contractor.

6.16 General Guarantee And Warranty

The Developer shall be required, upon completion of the work, and acceptance by the City, to furnish the City a written guarantee covering all material and workmanship for a period of two years after the date of final acceptance and he shall make all necessary repairs during that period at his own expense, if such repairs are necessitated as the result of furnishing, poor materials and/or workmanship. The Developer shall obtain warranties from the contractors, subcontractors and suppliers of material or equipment where such warranties are required, and shall deliver copies to the City upon completion of the work.

Easement documents, if applicable, shall be filed and recorded with the Pacific County Auditor's office and the documents reviewed by the City's Engineer and/or Attorney prior to project acceptance.

6.17 Sanitary Sewer Lift Stations

A. Objective

Section 6.17 is intended to present information and provide an outline of the **minimum** general standards to be accomplished in planning a sewage lift station installation within the City's service area. Other types of stations may be proposed for consideration, and/or mandated by local conditions as determined by the City Engineer.

The Developer shall submit to the City for review and approval, complete sewage lift station plans and design which provide for the lift station, electrical service/controls and telemetry system, and auxiliary generator/transfer switch together with all accessories for a complete, automatically operating installation.

Design material and drawings shall provide all civil, mechanical and electrical details and align with all applicable codes and regulations, and good engineering practice. The Developer shall be required to acquire all permits and approvals for the installation/construction of this facility as required from regulatory agencies.

The principle components of a sewage lift station installation will be addressed in the remainder of this section.

2. Lift Station
3. Electrical Service/Controls & Telemetry System
4. Auxiliary Power/Transfer Switch

B. Lift Station

1. Type

The type of sewage lift station to be furnished, supplied, and installed shall be at the City's sole discretion and option. Generally, the station shall be a submersible station or a buried, dry-pit-type, with an above-ground entrance hatch having a steel cover, lockable to City Standards, with anode protection. Other such stations shall be reviewed and approved by the City prior to construction. Construction shall be in compliance with O.S.H.A., U.L., A.S.T.M., N.E.C., and other applicable codes and regulations.

All sewage lift stations shall have, as a minimum, two sewage pumps. The pumps shall have sufficient capacity and capability to efficiently handle the peak design flow with one pump and to insure a minimum velocity of 3 feet per second in the force main. Design calculations and pump curves indicating the same shall be provided with the submittal information.

Each sewage pump shall be drilled, tapped and valved with 2-inch drainage fittings on the pump suction between the shut-off valve and the pump, and then piped to the sump.

The pump and motor shafts shall be the maximum diameter available for these units.

Pump motors shall be 3-phase, 60-cycle, and operate at the voltage as supplied by the utility company.

Three phase pump motors shall be N.E.M.A. standard starting or better as noted:

Code	Starting KVA/HP	Typical Size Range
A	0-3.15	---
B	3.15-3.55	---
C	3.55-4.0	---
D	4.0-4.5	---
E	4.5-5.0	---
F	5.0-5.6	15 HP & Up
G	5.6-6.3	10 HP
H	6.3-7.1	7.5 & 5 HP
J	7.1-8.0	3 HP
K	8.0-9.0	2 & 1-1/2 HP
L	9.0-10.0	1 HP
M	10.0-11.2	Less Than 1 HP

The sewage lift station supplier shall check the station during installation to determine if the installation is correct. Written confirmation of each visit and recommendations shall be provided to the City Engineer.

The sewage lift station supplier shall provide four hours of check-out training for City personnel at the station site during start-up.

The sewage lift station supplier shall provide four complete copies of maintenance and operation material to the City Engineer.

The Developer shall demonstrate that no surge problems exist with the station, and if found to exist, that they shall be corrected at no expense to the City.

Provide mouse proofing where applicable to ground-mounted structures.

All keys, miscellaneous items, and spare parts shall be given to the City prior to approval.

The Developer shall provide an area yard light for the lift station site. Landscaping and sound proofing/barriers shall be provided. Fencing and Drive Gates shall be furnished and installed. Potable water (hose bibs) shall be furnished and installed. Generator and transfer switch shall also be furnished and installed. Odor control facilities shall be provided at the station and/or discharge manhole. Corrosion protection and anchoring (bouancy) shall also be evaluated and provided when (in the City's opinion) necessary.

2. Capacity

The Developer shall perform a study and make the determination to assure that the lift station installation is sized to serve the overall sewage flows generated within the potential service area. The flow study shall include the Developer's plat boundary area as well as adjacent and future service areas (tributary areas). The service areas shall be the areas within that which could be served by the installation of the lift station(s). The City must review and approve of the developer submitted calculations and service area.

The station's design flow capacity shall be based on an average daily per capita flow with related peaking factors and inflow/infiltration allowances.

Documentation of present and future service area flow rates for lift station size and capacity determination shall be provided to the City.

The effects of the minimum flow conditions shall be estimated to be sure that retention of the sewage in the wet well will not create a nuisance and that pumping equipment will not operate too infrequently.

Lift station capacity shall meet the maximum rate of flow expected. The capacity of the receiving sewer shall also match the flow expected. At least two pump units shall be provided at each lift station installation, each capable of handling the expected maximum flow. Design calculations shall be provided regarding detention time at "start-up" and "build out". Odor control facilities as determined by the City may be required.

3. Location

The Developer shall furnish a site located outside of existing and future City right-of-way for the lift station. The site shall be approved by the City and deeded to the City.

The sewage lift station shall be located as far as practicable from present or proposed built-up residential areas, and an asphalt concrete access road shall be provided. Noise control, odor control, and station architectural design shall be taken into consideration. Sites for sewage lift stations shall be of sufficient size for future expansion or addition, if applicable.

The limits of the cut and fill areas for the lift station site and access shall be within the easement area and the slope of all embankments shall not exceed 2:1. The method of fill construction, i.e., compaction, etc., shall be noted on the plans. The easement shall be submitted to the City for review prior to construction of the lift station. Lift station sites not located within the plat boundary shall be procured by the developer and deeded to the City of Long Beach.

The water service to the lift station site shall be 1-inch with a 1-inch buried washdown hydrant, together with backflow preventer of the reduced pressure type, both installed near the wet well, including meter box, meter and hose bib and 1-inch heavy-duty rubber hose, 50-foot long with a spray nozzle.

A 6'-0" high galvanized chain link fence with vertical wooden redwood or plastic slats (City approved color) in-laid for screening, and a combination 12-foot wide gate all with 3 rows of barbed wire enclosing the lift station and generator site shall be provided. Fence fabric may include vinyl coating (color by City) if required and approved by City.

4. Wet Well

The wet well shall be of pre-cast concrete construction with flat slab cover and 30-inch hatch or manhole cover for access. The flat slab concrete cover shall be provided with a 4-inch vent which is "hooked and screened".

The wet well shall provide for the volute of the pumps to be fully submerged and a minimum of 3 minutes between pump cycles at pump capacity. The high water alarm shall be set a minimum of 7 inches below the invert of the lowest gravity sewer inlet pipe, or at an elevation as may be set by the City.

The wet well and the steel lift station shall be located on a common reinforced concrete slab. Protection against buoyancy shall be provided, together with the calculations to verify the same. The wet well chamber shall be provided with polypropylene safety steps as specified for typical precast manhole in accordance with the City's Standard Details.

The suction lines from the wet well to the pumps shall be a minimum of 6-inch inside diameter ductile iron, Class 53.

The force main shall be (unless otherwise specified or approved by the City Engineer) a minimum 6-inch diameter ductile iron Class 53, or PVC (C900) pipe (if approved by City Engineer) and provided with a continual positive slope. There shall be no intermediate high point between the pump station and the force main discharge point (depth shall be a minimum of 4'-0"). All pipes (gravity and pressure) entering and leaving the wet pit or dry pit shall have flexible couplings within 18-inches of the structure.

Odor control facilities may be required to be installed by the Developer based on design conditions and/or as required by the City Engineer.

An emergency pump connection shall be located near the wet well. A "pig" launching facility shall also be provided for maintenance of the force main. A "pig" is approved by the City shall also be provided.

C. Electrical Service/Controls and Telemetry System

1. General

Codes and regulations exist at the federal, state, and local level dictating minimum acceptable requirements for electrical systems. The following partial list of codes and regulations shall be used as a basis for design and review.

- National Electric Code (NEC)
- Occupational Safety & Health Act (OSHA)
- State & Local Building Codes
- National Electrical Safety Code (NESC)

Various manufacturers and technical societies publish standards and recommendations. The following partial list of standards and recommendations shall be used as a basis for design and review whenever the project specifications have not made them mandatory.

- National Electrical Manufactures Association (NEMA)
- Underwriters' Laboratory (UL)
- Insulated Power Conductor Engineering Association (IPCEA)
- American National Standards Institute (ANSI)
- Institute of Electrical & Electronic Engineers (IEEE)

2. Electrical Service

The local electric utility will be the primary source of electrical power. The Developer shall ascertain proper coordination between the nominal secondary delivery voltage supplied by Puget Sound Power and Light (PSP&L) and the connection to the lift station equipment. The electrical service shall be 4-wire, 3-phase, 60 hertz, with a solid neutral terminal at the disconnect or as may otherwise be required by local power company; this shall be confirmed with the local power company and confirmed by the suppliers.

The pump motors, generator and transfer switch shall match the utility supplied voltage.

All wire shall be copper.

All conduit shall be galvanized, rigid.
All installation shall be approved by the local power company and shall be in conformance with the N.E.C. (current issue) U.L. 98, O.S.H.A. and County and State electrical codes. The City shall be furnished with a certificate of final inspection by the various regulatory and inspecting agency(ies).

All underground conduits shall be marked with polyethylene tape placed 6-inches below finished grade and directly above the conduit.

All conduit shall have a minimum of 24 inches of cover.

Heating strips shall be provided for outside electrical enclosures.

A service entrance shall be provided with a pedestal on which shall be mounted, as a minimum, the following equipment:

a. Meter and meter can (as required by the PSP&L).

b. Meter C.T. (as required by the PSP&L).

c. Main disconnect circuit breaker in a N.E.M.A., 3-R, enclosure, with padlock to City standards.

d. A generator transfer switch, sized for the full connected load, in a N.E.M.A. 3-R enclosure, with padlock to City standards.

e. 277/480 Volt circuit, a 5 KVA minimum, 480 to 240/120-volt, single-phase transformer for outside installation with padlock to City Standards.

f. A 240/120-volt panel (12-circuit) in a N.E.M.A. 3-R enclosure with padlock to City standards.

g. A 120-volt duplex in N.E.M.A. 3-R enclosure with padlock to City standards.

h. Ground rod and connector wire in conduit to N.E.C. standards.

i. For mounting electrical equipment, provide two, 6'-0" high (above ground) 4" H.W. steel galvanized pipe support posts with H.W. galvanized *"super strut"* for supporting equipment; for minimum required the length of the pedestal secure to the posts. Post shall be encased in ground 3'-0" with 12-inch diameter concrete encasement. Enclose assembly in 8-inch thick poured-in-place concrete pad (finished surface 3 inches above ground), reinforced with #5 bars at 8 inches wide. Chamfer all concrete edges 3/4-inch.

j. When applicable, as determined by the City, include a galvanized roof structure over electrical enclosures.

k. Provide a 2-inch future conduit from a point 6 inches above the concrete slab as noted above, thence, underground to a point 24 inches from slab. Cap both ends.

Provide electrical single-line diagram showing all components and control between pedestal, lift station and generator with wire and conduit sizes.

The City shall be provided with a complete reproducible set of as-constructed Plans and Details showing final location of all equipment, conduit and wire.

3. Controls

Control and instrument system plans shall thoroughly and completely depict system design. The plans, in conjunction with the specifications, shall define the type of control system, the type of components in the system, set points and the interface between the instrumentation and control system and the lift station

system. To accomplish this, the control and instrument plan(s) shall include, as a minimum, the following

a. control and instrumentation system legend and general notes

b. control, instrumentation and distribution diagram

c. plans showing location of all control, instrument, and distribution system equipment and components, both electrical and pneumatic

d. all equipment and installation details

The power, control and instrumentation systems shall be designed with both operational reliability and maintainability. Use standard products wherever possible.

All components within the lift station system, including both internally and face-mounted instruments and devices, shall be clearly identified with phenolic nameplates of black background with white letters.

All wiring between cabinet, equipment and components shall be marked and multiple color coded where applicable.

All wiring shall be copper.

All pump motors shall have an independent circuit breaker located within the lift station and the lift station shall have a main circuit breaker located outside the lift station.

The lift station shall be furnished with a wet well gauge in the control panel. The control panel shall be furnished with an A-O-H switch for each pump motor and voltage monitor relays to protect the pump motors from single-phasing, phase reversal and low voltage.

The pump controls shall be air bubbler type with two compressors alternating on timer control, and shall provide for both pumps to operate at high water conditions. The control elevations shall be indicated on the plans, i.e., on-off, first pump on, second pump on, and high water alarm.

The single-phase transformer for the lift station shall be 5 KVA, or as required for proper operation of the single phase side system.

The lift station electrical circuit shall be modified for generator starting and telemetry as required.

Provide check valve limit switches and relays to confirm pump run to telemetry on each pump.

A complete set of spare fuses shall be provided for all fused equipment.

4. Telemetry

The lift station installation shall be installed with a complete telemetry system. This shall include all remote equipment, at the lift station, and all central based equipment, at the office of the City of Long Beach.

Telemetry shall be furnished and installed by Rugid and shall be compatible with any current system and shall send all signals to the City office. The alarm priority shall be: 1) telemetry line failure; 2) normal power failure; 3) water in dry pit; 4) high/low water wet well; and 5) pump failure; 6) generator run. All contacts shall close on alarm. The panel shall be installed within the lift station. A water level sensor shall be provided in the dry pit.

The City will coordinate with the telemetry supplier and further mandate those alarms which the City desires to transmit.

All telemetry equipment shall be installed in a single NEMA 3R metal enclosure with an inner and outer door and shall be padlocked to City Standards. This equipment shall be installed on the electrical service mounting rack.

For ease of serving and maintaining the equipment, all wiring shall be multi-colored and numbered, using solderless pressure connectors.

All major components, including relays, timers, tone transmitters, and receivers, and power supplies shall be identified using phenolic or vilam engraved labels.

A line (surge) protector unit shall be provided for the telemetry equipment. The unit shall protect the equipment from transient and electrical surges on the telephone line. Protection shall include line fuses and clamps for voltages over 25 volts, gas tubes shall be provided as an integral part of the lighting protection unit.

The telemetering between the central based system and the lift station site shall be performed over a voice grade circuit leased to the City from the local telephone company. The telemetry supplier shall coordinate with the City to ensure proper circuits are furnished.

D. Auxiliary Power System

1. General

Emergency power generation equipment shall be provided at the lift station site which will operate the lift station in the event of a commercial power outage.

It is essential that the emergency system be designed with capacity and rating to carry safely the entire connected lift station load.

The auxiliary power unit shall be complete in every respect and shall include, but not be limited to, the following:

1. Generator, control panel & circuit breaker.
2. Engine, radiator & exhaust system.
3. Fuel tank.
4. Generator set enclosure.
5. Automatic transfer switch.

6. Battery & rack.
7. Battery charger.
8. Conduit, wire and piping.

The auxiliary power unit shall be new, factory assembled, tested and as manufactured by Cummins/Onan, or owner approved equal. The generator set shall be manufactured and installed to all current electrical and other codes and regulations, as required by national, state, county and local agencies having jurisdiction.

Generator shall be capable of automatic starting and maintaining a full load from a cold start.

Generator shall have locking panels to engine and butterfly compartment. Fuel tank and radiator cap shall be lockable with common key.

Provide mouse proofing where applicable to ground-mounted structures.

2. Power System

Generator, engine and accessories enclosed in metal enclosure with removable panels and sides. Enclosures shall be lockable to City standards. Keys (two) shall be provided to City.

Generator shall be designed so that the danger of accidents to the operator will be minimized.

Suitable guards shall be provided on all electrical parts to minimize the personal shock hazard.

Generator shall be broken-in sufficiently to permit application of full load immediately upon installation.

Generator supplier shall provide all tools for the generator set as recommended and required by the manufacturer.

Generator installation shall be checked three (3) times by the supplier during construction to determine that the installation is correct. Written confirmation of each visit and recommendations shall be provided to the City.

Generator supplier shall provide two (2) eight (8) hour days of supervision during start-up.

Generator supplier shall provide training for City personnel. This training shall be four (4) hours in length, and shall be conducted at the lift station site.

Generator manufacturer shall provide four (4) copies of a maintenance and operations manual. These manuals shall be complete and shall include all information necessary to allow City personnel to maintain the generator.

Generator mounting pad shall be reinforced concrete to carry the weight of the unit and shall extend a minimum of 3 inches beyond generator housing. Chamfer all edges 3/4-inch.

Propane tank support pad shall be as above.

Provide a roof structure over generator. The structure shall be designed by the Developer's engineer and subject to the City's approval. It shall be designed to protect the generator and City personnel from inclement weather, to be utilized as a noise barrier, and be aesthetically pleasing to the surrounding area.

a. Engine

(Shall be provided with/have):

Unless otherwise approved by the City Engineer, the engine shall be propane fueled. No gasoline or diesel engines are permitted without written authorization of the City. Fuel tank shall be above-ground, separate from unit for propane. Capacity shall be 24 hours when full + 25% reserve.

Fuel system shall be provided with an electrical shut-off valve with flexible connection to the generator. The generator set shall be manufacturer in compliance with the following codes, regulations and standards; N.E.M.A., I.E.E., A.N.S.I., N.E.C. and O.S.H.A.

Generator recovery after acceptance of 100% rated load in one step shall be 1 second.

Cooling shall be by radiator, provided with anti-freeze protected to -45°F and with corrosion protection. Provide block heater. Radiator cover shall have padlock hasp and padlock to City standards.

Lubrication shall be full circulation pressure type, with replaceable filter with bypass.

Engine governor shall be gear-type mechanical.

Engine air filter shall be replaceable type.

Generator unit shall be furnished with vibration mounts.

Electrical fuel shut-off and flex-connections to engine.

Engine oil drain extension.

Stainless steel flexible exhaust connector and hospital (critical) rated muffler with condensation and rain collector including insulation.

Skid base with vibration isolators between base and concrete pad; secure to concrete per manufacturer's specifications.

High amperage industrial rated batteries and cables.

Battery charger capable of recharging battery in 4 hours from complete discharge.

Engine shall be 1,800 rpm, 4-cycle.

b. Generator

(Shall be provided with/have):

Designed and manufactured in accordance with N.E.M.A., I.E.E., and A.N.S.I. standards for temperature rise and all applicable electrical codes.

Revolving field, dynamically balanced, static excited, static regulated, 12-lead.

Upon application of rated continuous load, in one step, voltage dip shall be less than 25 percent or less with recovery to normal voltage in less than one second, measured with a light beam oscillograph.

Voltage regulation, solid state, within + 1 percent.

40°C temperature rise above 90°C ambient operation.

Frequency regulation within 3-hertz.

Radio suppression.

Self-ventilated, drip-proof construction.

Brushless, fast response, amortized winding, Class "B" and "F" fungus resistant. Coils and stator mechanically and epoxy braided.

Winding heaters shall be provided (120-volt).

Shock mounted.

Pump lockout circuit when generator is running (locked-out pump to be second call pump).
Low coolant level alarm shall shut down unit if coolant lever is low.

Generator shall be 3-phase, 60-cycle and shall match the supply voltage of the utility distribution system.

c. Control Panel

(Shall be provided with/have):

Three position selector switch (off, test, automatic), which shall include a red flashing indicator light which lights in the <u>off</u> position.

Manual start-stop switch for testing without interrupting normal source.

Contact for an alarm and report system (6 contacts) N.O./N.C.

Cranking reset button.

Over-cranking protection shall open cranking circuit after 30-90 seconds of cranking (adjustable).

Cranking cycler with four attempts of 15 seconds each and 10 second rest periods between attempts.

Line circuit breaker rated at full generator capacity.

AC volt meter with switch for each phase.

AC ammeter with switch for each phase.

Current transformers.

Frequency meter.

Running time meter (99,999.9 hours capacity)

Panel light.

Oil pressure gauge.

Water temperature gauge.

Voltage adjusting rheostat.

Alarm indication panel with shut-off control; 1) over-speed; 2) over-crank; 3) high temperature; 4) low oil pressure; 5) low coolant level.

All contacts shall close on alarm.

All alarm sensors and instruments shall be protected by individual push-type reset circuit breakers.

Generator load meter (to measure true load on generator) in kW.

Panel to be N.E.M.A. 12 construction.

3. Transfer Switch

The transfer switch shall be sized, in amps, to equal plus 25%, the full connected load of the lift station generator and auxiliary equipment. The transfer switch shall be enclosed in a N.E.M.A. 3-R cabinet with padlock to City standards and mounted on the entrance pedestal.

Shall be U.L., 1008 and C.S.A. approved.

Shall protect all types of loads, inductive and resistive.

Shall be rated, 3-phase, 60-cycle, 3-pole, 4-wire with neutral lug and match the commercially supplied system voltage.

Shall be rated for all classes of loads without de-rating, either open or closed.

Shall automatically transfer load upon failure of normal power and return upon restoration of normal power.

Shall be electrically operated, mechanically-held using circuit breakers.

Shall be provided with time delay in the neutral position.

The automatic transfer panel shall have solid state, close-differential, field-adjustable, voltage-sensing relays, nominally set at 70 percent drop-out and 90 percent pick-up, both modes: emergency to normal and normal to emergency.

Interrupting and withstand capacity, measured symmetrical of breakers shall be as follows:

40, 70, 100 amp =	14,000
150, 260 amp =	30,000
400,600 amp =	65,000
800,1000 amp =	65,000

The automatic transfer switch shall obtain current from the source to which the load is being transferred.

Panel shall be front opening.

All equipment listed shall be mounted directly in the automatic transfer panel lockable cabinet.

All equipment shall be accessible from the front of the cabinet for ease of maintenance or removal.

All pilot devices and/or relays shall be industrial type rated 10-amperes with self-cleaning contacts.

Components of the operation mechanism shall be insulated or electrically dead.

The transfer mechanism shall be energized only momentarily during transfer.

Components of linkages and handles of operating mechanism shall be ruggedly constructed and not subject to deterioration.

Time Delay - transfer from normal power source to standby generator set, shall be delayed in order to override momentary power fluctuations or outages. Adjustable, 0 to 50 seconds.

Time Delay - emergency to normal transfer shall be delayed after normal power resumes to permit stabilization of the normal power source prior to transfer. Adjustable, 30 seconds to 30 minutes.

Time Delay for Engine Cool-Off - a time delay shall allow the engine to run, unloaded for a period of not less than two minutes after power has been transferred back to the normal source. The time delay shall be adjustable from a minimum period of 60 seconds to 15 minutes.

Protection for under-voltage, over-voltage, phase reversal, single-phasing, unbalanced operating voltage; both modes - emergency to normal and normal to emergency.

Auxiliary Contacts - a minimum of six (6) pairs of auxiliary contacts shall be provided in the transfer switch panel, complete with switches to prevent chosen circuits from operating during periods of normal power outage. The contacts shall be cartridge type convertible from normally closed to normally open.

Time delay at the neutral position - when transferring from normal power to generator power and from generator power to normal power. Time delay shall be adjustable from 0.2 to 50 seconds.