SECTION 5
MINIMUM DESIGN CRITERIA

5.1 INTRODUCTION

Minimum design criteria for Water District 19's water system is in accordance with the standards and requirements put forth by the U.S. Department of Environmental Protection Agency (EPA), the Washington State Department of Health, King County and the District's own developer extension design and construction standards. The utilization of current design criteria is an important issue in the efficient operation of a water district and vital to the assessment of an existing water system. This is an important concept for identifying system deficiencies and future system requirements. Additionally, the District is within the Vashon Island Coordinated Water System and therefore subject to the standards and requirements put forth in that Plan.

The minimum design criteria addressed in this section will include water supply requirements, storage volume, pump station capacities, distribution system, transmission main capacities and water quality standards. These criteria are used to identify any existing system deficiencies as well as establish design requirements for the future water system within the planning area.

5.1.1 STATE AGENCY REGULATIONS

The Washington State Department of Health's "Water System Design Manual" (August 2001) is the primary document governing the sizing and design of Group A public water systems in the State of Washington. This publication sets forth the minimum system planning and reliability considerations. The criteria for distribution system design, water storage and daily supply requirements are summarized in this section.

5.2 REFERENCE

Reference datum for the District's design work and within the scope of the planning area and facilities for this plan is based on a vertical datum NAVD 88 and a horizontal datum based on NAD 27.

5.3 DESIGN PLANNING PERIOD

In planning water system facilities, it is necessary to design them to be adequate over a specific period of time. The period of design for this study is approximately 20 years. This means that in the year 2026, the facilities proposed in this study may have reached their maximum useful life, assuming that the population projections are obtained. Many of the water system components, however, have much longer useful lives than 20 years and will continue to provide adequate service to the community far beyond this design period. For

these facilities, sizing is based on build out scenarios. This would include pipe lines, reservoirs and other facilities with life spans of fifty to seventy-five years.

5.4 PLANNING CONSIDERATIONS

Initial system construction and additions should conform to the comprehensive plan and service area. Public water systems shall be designed to provide fire-fighting capability in accordance with the requirements of the local Fire Marshall. Phased development is permitted where full development will take several years.

5.5 RELIABILITY CONSIDERATIONS

Multiple water sources are recommended in combination with adequate emergency reserve in gravity storage to allow for the interruption of supply at one point while maintaining water supply to the system at the design rate. The looping of water mains to improve circulation quality and fire flow is recommended. Pump stations are to contain multiple booster pumps of sufficient capacity to meet the maximum day demand with the largest pump out of service. Auxiliary power is required where adequate gravity storage is not provided.

5.6 WATER SUPPLY

The State Department of Health “Water System Design Manual” recommends a source capacity that meets the maximum day demand while concurrently replenishing the fire suppression storage volume within 72 hours of its depletion. Water sources should be capable of providing the maximum day demand for the system with 18 hours of pumping. With the largest source out of service, the renaming source(s) shall meet the average day demand of the system.

5.7 WATER PRESSURE

Water systems shall be designed to provide an adequate quantity of water at a positive pressure of at least 30 psi under peak hour demand flow conditions, measured at any ratepayer's water meter.

For fire flow, the distribution system shall be designed to provide the required fire flow at a minimum residual pressure of 20 psi throughout the system during fire flows under maximum day demand flow conditions. The local Fire Marshal shall establish the required fire flow. Maximum pressures in the distribution system should not exceed 100 psi and individual pressure reducing valves shall be provided by the ratepayer for service connections that exceed 80 psi.

5.8 PIPE SIZING AND MATERIALS

Water mains shall be adequate to deliver required fire flows and the maximum day demand while maintaining minimum system pressures of 20 psi.

Maximum design velocity in distribution pipelines is not to exceed 8 feet per second (fps) under peak hour demand conditions, with minimum velocities of 2.5 feet per second. Flow velocities during fire events may exceed this maximum limit, but shall remain below 10 fps.

Minimum pipe diameter is 8-inches nominal inside diameter, except for looping and dead-end mains serving hydrants as approved by the District and based on hydraulical analysis. All pipelines shall be designed and constructed to ultimate domestic and fire flow conditions as determined by the District.

The District does not generally accept dead end mains, except in phased development projects or where no potential for future interconnection of facilities exists. Approved dead end mains that will not serve fire hydrants may be sized as hydraulically justified and approved by the District.

New water mains are to be constructed of cement-lined, ductile iron pipe conforming to AWWA C 151 and C 104, minimum thickness Class 52.

All push-on and mechanical joints shall conform to AWWA C 111, and restrained joints shall conform to District requirements.

All water system pipelines shall be constructed of "lead free" materials (less then 8% lead content).

Minimum cover over pipes shall be 36-inches from the top of pipe to the finished grade, unless otherwise approved by the District.

If possible, transmission and distribution pipelines shall be at least 10 horizontal feet from any existing or proposed waste disposal facilities. On crossings, at least 18-inches of vertical separation shall be maintained between the top of a sewer pipe and the bottom of a water line. Separation of water and sanitary sewer lines shall be in accordance with the State Department of Ecology's "Criteria for Sewage Works Design".

Polyethylene encasing or cathodic protection shall be utilized in areas of corrosive soil conditions, which may affect the life of pipelines, as determined by the District.

5.9 VALVES

Valves shall be ductile iron and installed in a configuration, which permits the isolation of lines.

Valves shall be installed at intersections with normal maximum spacing of 500 feet in commercial, industrial, and multi-family areas, 800 feet in residential areas, and 1/4 mile in transmission mains. Additional isolation valves may be required by the District and will be determined on a case-by-case basis.

Zone isolation valves shall be installed at pressure zone boundaries to permit future pressure zone realignment without the need for piping reconfiguration.

A blow-off assembly or fire hydrant shall be installed on all dead-end runs and at designated points of low elevation to provide a means for adequate flushing of the system. Blow-off assemblies shall be installed in a utility right-of-way, except where a written access and construction easement is provided to the District.

Air relief or combined air-vacuum relief valves are to be installed at appropriate points of high elevation in the system. System service lines may serve as air relief in certain instances. All piping in the system shall be sloped to permit escape of any entrained air.

5.10 FIRE HYDRANTS

Fire hydrants shall comply with the requirements established by the local Fire Marshal having jurisdiction, and meet the type, location and spacing requirements of the agency in the project area. In general, maximum spacing for hydrants in commercial and multi-family areas shall be 300 feet on center and 600 feet on center in residential areas.

5.11 CROSS-CONNECTION CONTROL

Where the possibility of contamination of potable water exists, water services shall be equipped with appropriate cross-connection control assemblies in accordance with State requirements and regulations (including WAC 246-290-490), the "Cross-Connection Control Manual, Accepted Procedure and Practice" published by the American Water Works Association. The need, size, tracking and location of cross connection assemblies shall be determined by the District.

5.12 STORAGE

Storage requirements are based on five components: operational storage, equalizing storage, standby storage, fire suppression storage and dead storage. The minimum requirements for each of the components of the total storage requirement are summarized below. The minimum amount of storage required shall be adequate to provide for equalizing storage plus the larger of standby or fire suppression storage. The recommended storage volume is equal to the sum of the equalizing, standby and fire suppression storage components.

5.12.1 EFFECTIVE STORAGE

The total volume of a reservoir or storage tank, as measured between the overflow elevation and the outlet elevation, may not necessarily equal the effective volume available to the water system. Effective volume is equal to the total volume less any dead storage built into the reservoir. Dead storage is defined as the volume of water stored and not available to all ratepayers at the minimum design pressure in accordance with WAC 246-090-230 (5) and (6). The dead storage volume is

excluded from the volumes provided to meet the operational, equalizing and fire suppression storage requirements.

5.12.2 OPERATIONAL STORAGE

The operational storage is the volume of water available to supply the system under normal operating conditions while the source is considered “off”. This volume varies according to the sensitivity of the water level sensors controlling the source pumps and the configuration of the tanks designed to provide the required volume while preventing excessive cycling of the pump motor(s). The volume of operational storage is therefore dependent upon pump design parameters, and is not impacted by the minimum design parameters set forth by DOH.

5.12.3 EQUALIZING STORAGE

Equalizing storage is the volume of water required to supplement source-pumping capacity when system demands exceed the source pumping capabilities. The volume of equalizing storage must be sufficient to meet hourly water system demands in excess of the rate of supply and must be at an elevation sufficient to meet these demands at a minimum delivery pressure of 30 psi. The amount of required equalizing storage is to be calculated in accordance with the DOH "Water System Design Manual”.

5.12.4 STANDBY STORAGE

Standby storage is required in order to augment the available supply of water during a period of restricted flow from the supply source. Restriction of flow may be caused by a pumping equipment failure, supply line failure, maintenance or repair, or other conditions that may cause interruption in supply. For single source systems, standby storage requirements are twice the average day demand for a system, deliverable at 20 psi. For a multiple source system, the standby storage is calculated as twice the average day demand, less the flow available with the largest source out of service, multiplied by the amount of time the remaining sources will be pumped each day. It is recommended that standby storage not be less than 200 gallons per connection per day.

5.12.5 FIRE SUPPRESSION STORAGE

Fire suppression storage must be equal to the amount of water required to accommodate fire demand while maintaining a minimum system pressure of 20 psi. Fire flow requirements are determined by the Fire Marshal having jurisdiction and generally conform to the procedures utilized by the Washington Surveying and Rating Bureau as set forth in "Guide for Determination of Required Fire Flow" published by the Insurance Services Office, Municipal Survey Service.

5.12.6 DEAD STORAGE

Dead storage is the amount of water not available to all ratepayers at the minimum design pressure. Dead storage is not considered when determining volumes to provide operational, equalizing, standby or fire suppression storage.

5.13 PUMP STATIONS

Pump stations shall provide a minimum of 20 pounds per square inch (psi) at the intake of the pumps under peak hour demand or fire flow plus maximum day demand conditions. If the intake pressure is to drop below 10 psi, pump stations shall have an automatic shut-off in place. Pump stations shall have power connections available to two independent primary power sources or provision for in-place auxiliary power if the station provides fire flow or are pumping from ground level storage. Open system Booster Pump Stations (BPS) which transfer water to a higher-pressure zone governed by an atmospheric storage tank shall be capable of providing source capacity as established for water supply sources. A closed system BPS that transfers water to a higher-pressure zone that is closed to the atmosphere shall provide peak hourly demand with a minimum of 30 psi of pressure at all connections. It is recommended that this capacity be provided with the largest pump out of service. The closed system BPS shall provide fire flow in conjunction with maximum daily demand at 20 psi residual pressure.

5.14 GENERAL FACILITY PLACEMENT

All piping, pumping, source, storage and other facilities, shall be located in public rights-of-way, dedicated utility easements or on District-owned property. Utility easements must be a minimum of 15 feet in width, and piping shall be installed no less than 5 feet from the easement's edge. Any exceptions to this minimum easement will be at the discretion of the District. Unrestricted access shall be provided to all public water system lines, their appropriate appurtenances and all public fire hydrants.

The location of utilities shall be in accordance with the standards and guidelines established by King County or the appropriate City's criteria. Where existing utilities or storm drains are in place, new facilities shall conform to these standards as nearly as practicable and yet be compatible with the existing installations. Where practical, there shall be at least 5 feet horizontal separation from other utilities.

5.15 STANDARD PLANS AND SPECIFICATIONS

In accordance with WAC 246-290-120, WD 19 maintains standard plans and specifications on file with DOH to satisfy approval requirements for routine actions of maintaining the system. These include such items as hydrant installation, replacement of components with similar components, and maintenance and painting of surfaces not in

contact with potable water. The standard plans and specifications also constitute a waiver from formal submittal and approval of specific distribution main improvements provided that construction of such projects are certified by a registered professional engineer as being in compliance with the standard specifications found in the DOH-approved water system plan. The District shall provide documentation to DOH of the pressure test results, disinfection procedures used and tests performed, and water quality sample results obtained prior to placing the distribution pipeline into service. All other water system improvements require submittal to and approval of the Washington Department of Health.

5.16 WATER QUALITY STANDARDS

In addition to providing water at appropriate quantities and pressures, the District is responsible for ensuring that the chemical and bacteriological quality of the water meets established public health standards. The maximum contaminant levels (MCLs) allowed in drinking water supplies are as put forth by the Washington State Department of Health (DOH) and the Federal Safe Drinking Water Act (SDWA). The District recognizes that additional monitoring requirements are forthcoming and will comply with such requirements as they are implemented in the State of Washington. Similarly, the District recognizes the SDWA requires a variety of source monitoring for surface water supplies, to insure compliance. The District's current and projected water quality monitoring program and water quality analyses of existing sources are provided in the Appendices.

5.16.1 EXISTING DRINKING WATER STANDARDS

The potential contaminants that can affect public water supplies and that are addressed in WAC 246-290 are described in the following general groups:

1. Bacteriological
2. Inorganic Chemical (IOC) and physical
3. Trihalomethanes (TTHM)
4. Disinfection Byproducts (TTHM, HAA5, Bromate, Chlorite)
5. Disinfection Residuals
6. Radionuclides
7. Organic Chemicals (volatile or VOC, and synthetic or SOC)

These are further divided into primary and secondary contaminants. Primary contaminants are those that pose a human health hazard. Secondary contaminants generally indicate aesthetic rather than acute or chronic health concerns. All of the characteristics in the list are considered primary standards with the exception of a small number of inorganic chemical/physical constituents.

For each of the contaminants identified, a maximum contaminant level (MCL) or maximum residual disinfectant level (MRDL) has been established. Routine monitoring and chemical testing of the system is required to allow the operations staff to adjust process controls to stay above or below the established limits.

The maximum contaminant levels established by DOH are shown in Table 5-1.

The EPA has recently issued additional rules that will have an impact on District operations. These include:

1. Filter Backwash Rule (2001) requiring all systems that recycle to return specific recycle flows through all processes of the system's existing filtration process.

2. Long Term 1 Enhanced Surface Water Treatment Rule (2002) generally requiring a 2-log removal of Cryptosporidium and setting locations and frequency of turbidity monitoring and turbidity levels.

3. Long Term 2 ESWTR (2006) (Schedule 4) requiring source water monitoring for disinfection effectiveness and a potential increase in treatment to achieve specified levels of Cryptosporidium removal.

5.16.2 ANTICIPATED FUTURE DRINKING WATER REGULATIONS

Additional requirements for monitoring, contaminant removal, and other water quality improvements are being considered. The District should remain alert to these rule-making efforts as they are identified and evaluate them on a case-by-case basis.

5.16.3 WATER QUALITY MONITORING SCHEDULE

Sampling and testing of the water provided to the District's customers is essential in ensuring that public health is protected and that treatment processes are optimized. Frequencies, locations, and targeted test parameters are specified by DOH regulation and EPA rules as well as by operator needs. The District's Water Quality Monitoring Schedule is addressed in the operations program outlined in Section 8.

TABLE 5-1
WATER QUALITY – MAXIMUM CONTAMINANT LEVELS

Inorganics	Primary MCL (mg/L)	Inorganic Chemicals	Secondary MCL (mg/L)
Antimony (Sb)	0.006	Chloride (Cl)	250.0
Arsenic (As)	0.010 [3]	Fluoride (Fl)	2.0
Asbestos	7 million fibers/liter	Iron (Fe)	0.3
Barium (Ba)	2.0	Manganese (Mn)	0.05
Beryllium	0.004	Silver (Ag)	0.1
Cadmium (Cd)	0.005	Sulfate (SO4)	250.0
Chromium (Cr)	0.01	Zinc (Zn)	5.0
Copper (Cu)	[1]	**Physical Characteristics**	**Primary MCL**
Cyanide	0.2	Turbidity	5 NTU
Fluoride (F)	4.0	Color	15 std color units
Lead (Pb)	[1]	Specific Conductivity	700 umhos/cm
Mercury (Ha)	0.002	Total Dissolved Solids	500 mg/L
Nickel (Ni)	0.1	**Disinfection By-Products**	**Primary MCL (mg/L)**
Nitrate (as N)	10.0	Total Trihalomethanes (TTHM)	0.080 [2]
Nitrite (as N)	1.0	Haloaecetic Acids-five (HAA5)	0.060
Selenium (Se)	0.05	Bromate	0.010
Sodium (Na)	[1]	Chlorite	1.0
Thalium (Tl)	0.002	**Disinfectant Residual**	**Primary MRDL (mg/L)**
Organic Chemicals	**Primary MCL**	Chlorine	4.0 (as Cl_2)
Volatile Organic Chemicals	40 CFR 141.61(a)	Chloramines	4.0 (as Cl_2)
Synthetic Organic Chemicals	40 CFR 141.61(c)	Chlorine Dioxide	0.8 (as ClO_2)

Source: WAC 246-290-310

Notes: [1] Although the State Board of Health has not established MCLs for copper, lead, and sodium, there is sufficient public health significance connected with copper, lead, and sodium levels to require inclusion in inorganic chemical and physical source monitoring. For lead and copper, the EPA has established distribution system related levels at which a system is required to consider corrosion control. These levels, called "action levels," are 0.015 mg/L for lead and 1.3 mg/L for copper and are applied to the highest concentration in ten percent of all samples collected from the distribution system. The EPA has also established a recommended level of twenty mg/L for sodium as a level of concern for those consumers that may be restricted for daily sodium intake in their diets.

[2] The MCL for TTHM is calculated on the basis or a running average or quarterly samples.

[3] This MCL is effective January 23, 2006. Until then, the MCL is 0.05 mg/L.