Design Criteria & Service Goals

Section 4

4.1 Design Life of Improvements

The design life of a water system component is sometimes referred to as its useful life or service life. The selection of a design life is a matter of judgment based on such factors as the type and intensity of use, type and quality of materials used in construction, and the quality of workmanship during installation. The estimated and actual design life for any particular component may vary depending on the above factors. The establishment of a design life provides a realistic projection of service upon which to base an economic analysis of new capital improvements.

As discussed in Section 1, the planning period for this Water System Master Plan is 20 years ending in the year 2030. The planning period is the time frame during which the recommended water system is expected to provide sufficient capacity to meet the needs of all anticipated users. The required system capacity is based on projections of population, EDUs, water demand, and land use considerations.

The planning period for a water system and the design life for its components may not be identical. For example, a properly maintained steel storage tank may have a design life of 60 years, but the projected fire flow and consumptive water demand for a planning period of 20 years determine its size. At the end of the initial 20-year planning period, water demand may be such that an additional storage tank is required; however, the existing tank with a design life of 60 years would still be useful and remain in service for another 40 years. The typical design life for system components are discussed below.

4.1.1 Pumping Equipment and Structures

Major structures and buildings should have a design life of approximately 50 years. Pumps and equipment usually have a useful life of about 15 to 20 years. The useful life of some equipment can be extended, when properly maintained, if additional capacity is not required. Flowmeters typically have a design life of 10 to 15 years. Valves usually need to be replaced after 15 to 20 years of use.

4.1.2 Treated Water Transmission and Distribution Piping

Water transmission and distribution piping should easily have a useful life of 50 to 60 years if quality materials and workmanship are incorporated into the construction and the pipes are adequately sized. Steel piping used in the 1950's and 60's that has been buried, commonly exhibits significant corrosion and leakage within 30 years. Cement mortar lined ductile iron piping can last up to 100 years when properly designed and installed. PVC and HDPE pipe manufacturers claim a 100-year service life for pipe as well.

4.1.3 Treated Water Storage

Distribution storage tanks should have a design life of 60 years (painted steel construction) to 80 years (concrete construction). Steel tanks with a glass-fused coating can have a design life similar to concrete construction. Actual service life will depend on the quality of materials, the workmanship during installation, and the timely administration of maintenance activities. Several practices, such as the use of cathodic protection, regular cleaning and frequent painting can extend or assure the service life of steel reservoirs. Painting intervals for steel tanks is 15 to 25 years. The life of steel tanks is greatly reduced if not repainted periodically as needed.

4.2 Sizing and Capacity Criteria and Goals

The 20-year projected water demands presented in Section 6 are used to size improvements. Various components of the system demand are used for sizing different improvements. Methods and demands used are discussed below.

4.2.1 Water Supply

Water supply must at minimum be sufficient to meet the projected 20-year maximum daily demand (MDD). If possible, raw water availability should meet a longer-term need considering the difficulty in obtaining new water rights. Currently the MDD is 4.1 million gallons per day (mgd) or 6.34 cubic feet per second (cfs). At the end of the 20-year planning period, the projected MDD is 5.8 mgd or 8.97 cfs. In order for the treatment plant to meet system needs without requiring 24 hour per day operation, allowing for modest downtime for maintenance and cleaning, a 20-year supply goal of 10.83 cfs is recommended. In order to plan for long-term water supply options, projections beyond the planning period were made using the same growth rate as the planning period and similar 20 hour per day plant operation time.

Supply Capacity Goal – 20-year MDD of 7.0 mgd (10.83 cfs)
Supply Capacity Goal – 40-year MDD of 9.0 mgd (13.93 cfs)
Supply Capacity Goal – 60-year MDD of 11.5 mgd (17.79 cfs)

4.2.2 Water Treatment

Water treatment plant equipment and components such as intake pumps, discharge pumps, clearwells, and filtration capacity are typically sized to provide for the 20-year MDD. The actual plant capacity should be increased slightly to allow for the maximum daily demand to be met without requiring the plant to run 24 hours per day. This is suggested since the plant cannot typically run 24 hours per day as filter backwashing and other down-times are needed to produce safe drinking water. The goal is to produce the projected MDD with no more than 20 hours of plant run time per day allowing for 4 hours per day of down time. As indicated above, the projected MDD is 5.8 mgd. The water treatment facility should be sized to treat up to 7.0 mgd which will result in 5.8 mgd available to the system during 20 hours of plant operation. The instantaneous flow rate through the plant will be 4,860 gallons per minute (gpm).

Treatment Capacity Goal – 20-year MDD with 20 hrs. Runtime, 7.0 mgd

4.2.3 Treated Water Storage

Total storage capacity must include reserve storage for fire suppression, equalization storage, and emergency storage. In larger communities it is common to provide storage capacity equal to the sum of equalization storage plus the larger of fire storage or emergency storage. In small communities it is recommended that total storage be the sum of fire plus equalization plus emergency storage. This is considered prudent since it is possible for fire danger to increase during water emergencies, such as power failures when alternative sources of heating and cooking might be used.

Equalization storage is typically set at 20-25% of the MDD to balance out the difference between peak demand and supply capacity. When peak hour flows are known, equalization storage is the difference between the MDD and PHD for a duration of 8 hours [PHD-MDD x 8 hrs.].

Emergency storage is required to protect against a total loss of water supply such as would occur with a broken transmission line, an electrical outage, equipment breakdown, or source contamination. Emergency storage should be an adequate volume to supply the system's average daily demand for the duration of a possible emergency. For most systems, emergency storage should be equal to one maximum day of demand or 2.5 to 3 times the average day demand.

Fire reserve storage is needed to supply fire flow throughout the water system to fight a major fire. The fire reserve storage is based on the maximum flow and duration of flow required to confine a major fire. The guidelines published in "Fire Suppression Rating Schedule" by the Insurance Services Office (ISO) are typically used to determine the required fire flow and fire reserve storage. Generally, fire flows of 1,000 to 1,500 gpm are sufficient for one or two family dwellings not exceeding two stories in height. Commercial, industrial and institutional buildings require higher flows. Determination of these flows is unique to each building under consideration and involves detailed surveys of construction (type and area), occupancy (combustibility), exposure (construction type, distance, length/height of wall) and communications (openings).

The ISO also classifies fire protection capabilities on a numerical basis, called the Public Protection Classification (PPC) with Class 1 representing exemplary protection and Class 10 indicating less than minimum protection. This classification is used within the insurance industry for various purposes. The Public Protection Classification is determined from a complex analysis of the City's capabilities to receive and handle fire alarms, of the strength of the fire department, and of the adequacy of the water supply system. Analysis of the water supply system is further divided into equal parts of: 1) supply capabilities, 2) hydrant size, type, and installation, and 3) inspection and condition of hydrants. For a PPC Class 8 rating or better, fire storage should be adequate to support needed fire flows as follows: 2 hours when less than 3,000 gpm is needed, 3 hours when flows of 3,000 to 3,500 gpm are provided, or for 4 hours when flows greater than 3,500 gpm are needed.

For typical residential areas, the minimum recommended fire storage is 120,000 gallons to provide a flow up to 1,000 gpm for 2 hours. When significant non-residential structures exist with fire fighting requirements greater than typical residential requirements, additional fire protection storage can be justified. The 2007 Oregon Fire Code outlines fire flow and duration requirements based on building classification and size.

In Newport there are several significant structures (i.e. Schools, governmental buildings, large commercial/industrial buildings, etc.) which justify the need for additional fire storage well beyond the minimums recommended for residential areas. A fire flow of 4,000 gpm for 4 hours is required by the Oregon Fire Code (Table B105.1) for certain buildings that may occur in Newport. A fire flow of 4,000 gpm for 4 hours will consume a volume of 960,000 gallons.

Another important design parameter for treated water storage reservoirs is elevation. Efforts should be made to locate all reservoirs at the same elevation when possible within a pressure zone. As a consistent water surface is maintained in all reservoirs, the need for altitude valves, pressure reducing valves (PRVs), booster pumps, and other control devices may be minimized. Distribution reservoirs should also be located at an elevation that maintains adequate water pressure throughout the system; sufficient water pressures at high elevations and reasonable pressures at lower elevations. The ideal pressure range for a distribution system is between 40 and 80 psi.

For subdivisions at higher elevations than allowed within the main pressure zone, storage tanks should be required when possible rather than hydropneumatic tank booster pump stations. Tank size needs to be determined on a case-by-case basis as part of the design review. Fire pumps with a capacity of at least 1,000 gpm together with standby generators should be provided when a storage tank is not possible. Minimum tank size should be 120,000 gallons fire storage (1,000 gpm for 2 hours) plus 1 times the MDD per EDU. For very small developments, individual sprinkler systems may be most appropriate.

Storage Capacity Goal – 1.25 x $MDD_{20\text{-}year}$ + 960,000 fire storage = 8.2 MG

4.2.4 Distribution System

Distribution mains are typically sized to convey projected maximum day flows plus simultaneous fire flows while maintaining at least 20 psi at all connections, or projected peak hourly flows while maintaining approximately 40 psi, whichever case is more stringent. Mains should be at least six inches in diameter to provide minimum fire flow capacity. The State of Oregon requires a water distribution system be designed and installed to maintain a pressure of at least 20 psi at all service connections (at the property line) at all times. OAR 333-061-0050 governs the construction standards for water systems including distribution piping. The size and layout of pipelines must be designed to deliver the flows indicated above.

The installation of permanent dead-end mains and dependence of relatively large areas on a single main should be avoided. In all cases, except for minor looping using 6-inch or larger pipe, a hydraulic analysis should be performed to ensure adequate sizing.

Distribution Capacity Goal – Worst Case of projected MDD + fire flow with at least 20 psi residual pressure or Projected PHD with 40 psi residual pressure

4.2.5 Fire Protection

According to the 2007 Oregon Fire Code, the minimum fire-flow requirements for one- and two-family dwellings not exceeding 3,600 s.f. shall be 1,000 gpm. When square footage exceeds 3,600 or for other types of buildings the minimum fire flow is 1,500 gpm. When flows of 1,750 gpm or less are required a single fire hydrant is required to be accessible within 250 feet (200 feet on dead-end streets) resulting in a maximum hydrant spacing of 500 feet (400 feet on dead-end streets).

For other types of structures, the requirements of the Oregon Fire Code require flows up to 8,000 gpm (2007 OFC Table B105.1). For fire flows less than 2,750 gpm a flow duration of 2 hours is required. For flows between 3,000 and 3,750 gpm a duration of 3 hours is required. For flows of 4,000 gpm and above a duration of 4 hours is required. The minimum number of hydrants available at a specific location, the average spacing between hydrants, and the maximum distance from any point on the street to a hydrant are dependent on the fire-flow requirement. For structures which require 4,000 gpm at least 4 hydrants must be available spaced not more than 350 feet apart.

Fire Flow Capacity Goals – Residential Only Outlying Areas; 1,000 gpm
Fire Flow Capacity Goals – General Commercial Areas; 1,500 gpm
Fire Flow Capacity Goals – Central Town Area and Along Hwy. 101; 3,000 gpm
Fire Flow Capacity Goals – Major Structures and Schools; 4,000 gpm

4.3 Basis for Cost Estimates

The cost estimates presented in this Plan will typically include four components: construction cost, engineering cost, contingency, and legal and administrative costs. Each of the cost components is discussed in this section. The estimates presented herein are preliminary and are based on the level and detail of planning presented in this Study. Construction costs are based on competitive bidding as public works projects. As projects proceed and as site-specific information becomes available, the estimates may require updating.

4.3.1 Construction Costs

The estimated construction costs in this Plan are based on actual construction bidding results from similar work, published cost guides, and other construction cost experience. Construction costs are preliminary budget level estimates prepared without design plans and details.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index (CCI) is most commonly used. This index is based on the value of 100 for the year 1913. Average yearly values for the past 15 years are summarized in Table 5.3.1-1.

Table 4.3.1-1 – ENR Index 1990-2007

YEAR	INDEX	% CHANGE/YR
1990	4732	2.54
1991	4835	2.18
1992	4985	3.10
1993	5210	4.51
1994	5408	3.80
1995	5471	1.16
1996	5620	2.72
1997	5826	3.67
1998	5920	1.61
1999	6059	2.35
2000	6221	2.67
2001	6343	1.96
2002	6538	3.07
2003	6694	2.39
2004	7115	6.29
2005	7446	4.65
2006	7751	4.10
2007	7967	2.78
	Average since 2000	3.84%

Cost estimates presented in this Plan are based on the average of 2007 dollars with an ENR CCI of 7967. For construction performed in later years, costs should be projected based on the then current year ENR Index using the following method:

Updated Cost = Plan Cost Estimate x (current ENR CCI / 7967)

4.3.2 Contingencies

A contingency factor equal to approximately fifteen percent (15%) of the estimated construction cost has been added to the budgetary costs estimated in this Plan. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs. Upon final design completion of any project, the contingency can be reduced to 10%. A contingency of at least 10% should always be maintained going into a construction project to allow for variances in quantities of materials and unforeseen conditions.

4.3.3 Engineering

The cost of engineering services for major projects typically include special investigations, predesign reports, surveying, foundation exploration, preparation of contract drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 18 to 25% of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small or complicated projects. Engineering costs for design and construction services presented in this Plan are based on 20% of the estimated total construction cost.

4.3.4 Legal and Administrative

An allowance of four percent (4%) of construction cost has been added for legal and administrative services. This allowance is intended to include internal project planning and budgeting, grant administration, liaison, interest on interim loan financing, legal services, review fees, legal advertising, and other related expenses associated with the project that could be incurred by the City.

4.3.5 Land Acquisition

Some projects may require the acquisition of additional right-of-way, property, or easements for construction of a specific improvement. The need and cost for such expenditures is difficult to predict and must be reviewed as a project is developed. Effort was made to include costs for land acquisition, where expected, within the cost estimates included in this Plan.