PART XIII – RECYCLED WATER SYSTEM DESIGN CRITERIA

A. Recycled Water Distribution, General

1. The design of the recycled water system shall be in accordance with all applicable State and City Codes, Regulations, Standards and Guidelines namely the California Code of Regulations, Titles 17 and 22, Redwood City Recycled Water Use Code Chapter 38 Article VIII, Redwood City Customer Guidelines for Recycled Water Use, Redwood City Recycled Water Development Standards (Attachment U of the Redwood City Engineering Standards, Volume 3: Design Criteria), and this Criteria. In the case of discrepancy or ambiguity among these documents, the most stringent requirement shall prevail.

2. The water system layout shall be approved by the City Engineer.

3. All recycled water mains and service laterals on private properties and private streets serving private properties shall be privately owned and maintained. However, in certain special circumstances where the recycled water mains are required to be owned by the City, the developer shall provide easements as necessary and required by the Engineering Division for recycled water lines and accessories. The minimum width of easement shall be 15’ clear of any property line fences.

4. The pipes must be sized for the design flow. Minimum size recycled water main shall be eight inches in inside diameter.

5. Calculations or computer modeling may be required for sizing more complicated recycled water systems and for evaluating the impact on the existing systems, as determined by the City Engineer.

B. Recycled Water Demand Projection

1. The Average Day domestic Recycled Water Demand Projection for new buildings is calculated using the ATTACHMENT Q with the following conversion factors:
   i. Indoor Residential – 25% of Attachment Q value.
   ii. Indoor Office/Commercial – 80% of Attachment Q value.
   iii. Outdoor Residential and Commercial Landscaping – 100% of Attachment Q values.
   iv. Other occupancy categories to be reviewed on a case by case basis.

2. The terminology and peak demand conditions in Sections B.3 to B.5 and D below are used in the latest hydraulic model (2010-2019) for hydraulic analyses. More information can be found in the Water Recycling Feasibility Study Update by Kennedy/Jenks Consultants dated August 28, 2012. These demand projections and peaking factors will be studied and updated in the near future as more meter data become available.

3. **Average Annual Demand (AAD)** – represents the annual irrigation demand during a year with average climate conditions and is typically expressed in acre-feet per year (AF/yr). AAD was estimated in the Market Assessment using 2008 meter records for existing customers (adjusted to account for annual variations in weather/climate conditions and for additional conservation measures that have been implemented since
2008) and water demand projections developed in the 2010 UWMP for future development/redevelopment.

Note: New demand or changing demand projections due the new and/or revised water and/or recycled water usages from the site (re)development can be (re)calculated and updated using methods outlined in Section B.1 above.

4. **Peak Day Demand (PDD)** – represents the largest demand that would need to be provided for irrigation and non-irrigation uses over any 24-hour period and is typically expressed in million gallons per day (MGD). The PDD is used to establish the daily supply requirement from the recycled water system and to evaluate if storage capacity is sufficient to ensure adequate supply over the course of the day. Analysis of the City’s recycled water DPS operation in 2008 and 2009 provided a range of observed peaking factors that can be used to estimate peak demand conditions in the system.

Demands during the peak day are comprised of the following:
- 9 hours of irrigation at the 60-minute interval peaking factor (8.7)
- 12 hours of non-irrigation demand at a peaking factor of 4.1
- Assume that 85% of annual demands are irrigation, 15% are non-irrigation

Therefore, PDD = 85% x AAD x 8.7 x 9/24 + 15% x AAD x 4.1 x 12/24 = AAD x 3.0

From this analysis, PDD is estimated to be 3 times the average annual demand:

PDD = AAD x 3.0

5. **Peak Hour Demand (PHD)** – represents the instantaneous demand on the system during the peak day, typically expressed in gallons per minute (gpm). The PHD typically occurs during nighttime irrigation hours and is used to establish the size of pipeline facilities and pumping requirements. Analysis of the City’s recycled water DPS operation in 2008 and 2009 provide a range of observed peaking factors that can be used to estimate peak demand conditions in the system. Based on the 2008 and 2009 analysis, a peaking factor of 10 is used to determine peak demand conditions (5-minute interval peaking factor):

PHD = AAD x 10.0

C. **Fire Flow Requirement**

1. None. The Recycled Water system is not designed to serve as a fire suppression or firefighting system.

D. **Recycled Water Storage, Pumping and Transmission Facilities**

1. The storage volume was sized to be equivalent to at least one day of the peak day demand.

2. Pumping and pipeline facilities were sized to deliver peak hour demands for all the customers included in the certified EIR (System built-out 3,238 AF/yr). The sizing of these conveyance facilities was based on computer modeling of the system using the day and night operating scenarios, based on planning assumptions for peaking of irrigation and non-irrigation demands. Storage was intended to be constructed in
phases. During Phase 1, two, 2.18 MG tanks were placed into service. The Ultimate Phase (build-out) is intended to include an additional 2.18 MG tank, bringing total storage capacity to 6.54MG.

3. Maximum allowable main line pressure is 100 psi. Note that the voluntary Delta-10 Potable Water system safe guard protocol limits this maximum recycled water system supply pressure down to 65 psi at the pump station facility at Radio Road in Redwood Shores, which approximately 10 psi below the potable water system pressure in the same area. City has plans work with the State Water Resources Control Board, Division of Drinking Water to remove this voluntary pressure limitation to improve system performance.

4. Minimum pressure in the recycled water system is 55 psi under peak hour demand conditions. Booster pump station(s) and storage facilities must be added to the system as necessary to provide adequate service pressures. It's anticipated that high system demand in the near future could lower service pressure in certain areas to as low as 30 psi. Provisions for on-site booster pumps must be provided or pumps be built by development projects.

5. Prior to 2015, internal pipeline diameters and friction coefficients for PVC pipe are used to model the system. A Hazen-Williams Coefficient of 130 is used, in accordance with the recycled water system calibration performed in 2009/2010.

6. Starting from 2016, all new underground recycled water mains shall be AWWA C-906 HDPE SDR11 PR 200 PSI PE4710 with a Hazen-Williams Coefficient of 140.

7. Maximum velocity in the recycled water system is 5 ft/sec in accordance with City design practices.

8. Maximum head loss is 5 feet per 1000 ft of pipeline, in accordance with City design practices.

9. Minimum distribution pipeline size is 8-inches inside diameter.

10. Steady state analysis using a hydraulic grade line using a reference elevation of 95.69 and DPS discharge pressure of 67.8 psi (assumed to be typical operating conditions). This pressure calculates to a starting point for the HGL of 252.15 ft.

11. The pipelines are sized to preserve future flexibility, consistent with the methodology used to size Phase 1 pipelines, to eventually deliver up to 3,238 AF/yr.

12. The model simulates nighttime demands because the peak demands occur during the nighttime irrigation period. Although nighttime demands are primarily due to irrigation, the system will experience a small amount of nighttime demands for non-irrigation uses
(i.e., occasional 24-hour concrete batching operations, toilet flushing). Unless actual nighttime demands can be determined or accurately estimated, a factor of 1.05 was applied to the nighttime peak irrigation demands to account for nighttime non-irrigation demands (i.e., assume that nighttime non-irrigation demands add 5% to irrigation demands).

E. Alignment

1. Minimum clearances shall be 5 feet horizontally and 1 foot vertically clearance outer edges to outer edges from any other underground pipe. Recycled water mains shall be installed at least 5 feet horizontally and 1 foot vertically below clearance outer edges to outer edges from any potable water main.

2. Recycled water mains shall be installed above potable water mains. Where this clearance is not practical, consult the California Administrative Code (Health Code) for potable water separation standards and alternatives.

3. Minimum cover shall be 4' from finished grade to top of pipe, or 2' below subgrade, whichever is greater.

4. The system shall be 'looped' from the street main, as required to maintain good system water quality.

5. Gate or butterfly valves shall be installed to isolate each branch run from main supply run. Valves 12" and larger shall be butterfly valves, and 10" and smaller shall be gate valves.

6. Air release valves at high points, and mid-line blow offs at 500 ft. minimum spacing & at low points will be installed at locations required by the Engineering Division.

F. Materials

1. Pipeline materials for mains shall be HDPE (IPS DR 11 PE4710 CL200) conforming to the requirements of the City's Standard Technical Specifications.

2. Valves and buries shall be cast iron and fusion epoxy coated and lined, conforming to City Standard Specifications.

3. Fittings shall be HDPE PE4710 CL200 conforming to City Standard Specification.

4. Recycled water mains shall be pressure tested and flushed prior to connection to the City's system, conforming to City Standard Technical Specifications.

G. Cathodic Protection

1. Recycled water systems in areas east of El Camino Real shall, in addition to other coatings called for in the specifications, have cathodic protection using a Petrolatum Wax Tape System for isolated metal fittings, metal valves and metal restraining devices. Otherwise, Cathodic Protection Anode shall be used as called for in the Engineering
Standards Specification Section 02661 “Cathodic Protection” and in the Engineering Standard Detail “Cathodic Protection at Fittings and Valves”.

2. For recycled water systems in areas west of El Camino Real, and east of the Alameda de las Pulgas the soils shall be tested for corrosivity using the procedures described in Appendix "A" of AWWA C-105. Any soil having a soil-test evaluation of 10 points or more shall require the use of cathodic protection to protect any metal appurtenances. Provide cathodic protection per G.1 at known hot spots and/or in lieu of corrosivity testings.

H. Recycled Water Services

1. Separate recycled water services and meters shall be installed in separate trenches.

2. Minimum service size shall be two (2) inch.

3. Meter boxes shall be located where they are easily accessible to the meter reader, in the landscaping strip or back of sidewalk and set parallel to the curb. Meters may not be closer than three feet to a driveway and out of the way of parked vehicles. Meter box lids shall be purple and stamped with the text “Recycled Water – Do Not Drink”

4. Services shall not be located closer than five feet from a sewer lateral, and/or ten feet from a potable water service lateral with a minimum of 24" of cover.

5. Recycled water meters may be installed by the City upon payment of the appropriate fee, and per the requirements as set forth in the City’s Recycled Water Development Standards.

6. Backflow prevention devices on/orer the recycled water system, as/when required by the City Engineer, are to be supplied, installed and maintained by the property owner.

I. Thrust Blocks

1. Thrust blocks shall be designed for a minimum operating pressure of 225 psi, with soil bearing pressures of 2000 psf, unless smaller soil pressures are recommended by the project geotechnical engineer.

2. In Bay Mud conditions, thrust blocks shall be designed with spread footings so as not to exceed the allowable bearing pressure of the soft Bay Mud (approximately 600 psf – See Part IX of this Volume for more requirements). Consult the project geotechnical engineer.

J. Backflow Prevention Devices on Potable Water System Serving the Same Site as the Recycled Water System

1. All private water supply pipelines shall be provided with an approved backflow prevention device.

2. Backflow prevention device shall be in the form of a Reduced Pressure Principle Backflow Preventer, per City Standard Details.

3. The type of Backflow preventer will be determined by the Engineer, depending on whether the location is deemed to be a low hazard potential, or whether dangerous or toxic substances are involved.
4. Backflow prevention devices shall be approved by the County of San Mateo, shall bear the stamp of Underwriters Laboratories (U.L.); and be listed by the University of Southern California at [www.usc.edu/dept/fccchr/list.html](http://www.usc.edu/dept/fccchr/list.html).

5. Devices shall be installed on private property, and immediately downstream of the meter.

K. Maintenance Requirements

1. Unless otherwise noted, the City will maintain the publicly owned recycled water mains and domestic water services in public streets up to and including the domestic meter.

2. Property owners shall maintain backflow prevention devices, meter boxes, recycled water service runs beyond the meter.

L. Seismic Design for Recycled Water Pipelines

1. Special attentions and seismic design requirements shall be applied in areas of largest potential permanent ground movements (including settlements and lateral spreads) due to seismic-induced liquefaction or cyclic softening of soft clays. These areas are located within 200 feet of creeks, sloughs, culverts and San Francisco Bay (high water level), underlain by the Young Bay Mud or Liquefiable deposits. They are shown on the map in Attachment T as Area 1.

2. Special attentions and seismic design requirements shall also be applied to hilly service areas west of Alameda De Las Pulgas where there are high probabilities of earthquake-induced landslides. They are shown on the map in Attachment T as Area 2.

3. Special attentions and seismic design requirements shall be optional and required on a case-by-case basis for the remainder of the city service areas east of Alameda De Las Pulgas and west of US 101 mentioned in Paragraph 1 and 2 above. They are shown on the map in Attachment T as Area 3.

4. Pipelines require seismic designs shall be designed for seismic hazards in accordance to latest and applicable AWWA standards and the 2005 American Lifelines Alliance’s Seismic Guidelines for Water Pipelines (ALA 2005) with reference to the City’s Seismic Vulnerability Assessment Report (G&E September 2011 – Chapter 3). ALA (2005) provides guidance for selection of pipeline importance factors, return periods for earthquakes, methods to estimate soil permanent ground deformations, allowing pipe stresses and strains. These may be refined by cognizant geologists, geotechnical, civil, structural engineers and professionals, as approved by the City.

5. Minimum seismic design requirements are:

   a. The design of new pipes in the mapped area requires that the pipe should be reliable to withstand the seismically-induced permanent soil movements. Lacking site-specific calculation, the pipe should be able to sustain a 1% change in pipe length. This can be done by using fully-restrained pipe that can reliably stretch (yield) 1%; or have sufficient flexible joints to absorb the equivalent movement.

   b. Submit seismic design calculations to document the design and installation of pipes 16-inches in diameter (nominal) and larger, and of critical pipes regardless
of size as determined by the City Engineer. The design procedure may follow guidelines in ALA (2005).

c. Detailed seismic design calculations are optional for the remainder pipe sizes and classifications. Chart Method (ALA 2005) – Design Approach for Pipe Category C (Restrained Joints) - may be used for these pipes instead.

d. Acceptable alternatives to meet this 1 percent strain are:
   i. Fully restrained High Density Polyethylene (HDPE) pipe with full penetration welds.
   ii. Or approved equals.

e. All pipes to be provided with suitable corrosion protection.

f. All designs to meet AWWA requirements for all other loadings.

g. Service laterals, blow offs, air and vacuum release and other appurtenances will be installed to resist the corresponding seismic loads, or installed in manner so that can be isolated (valved out) within 3 feet (1 meter) of the main.

h. Alternative designs meeting the intent of ALA (2005) and the City Standards may be submitted.