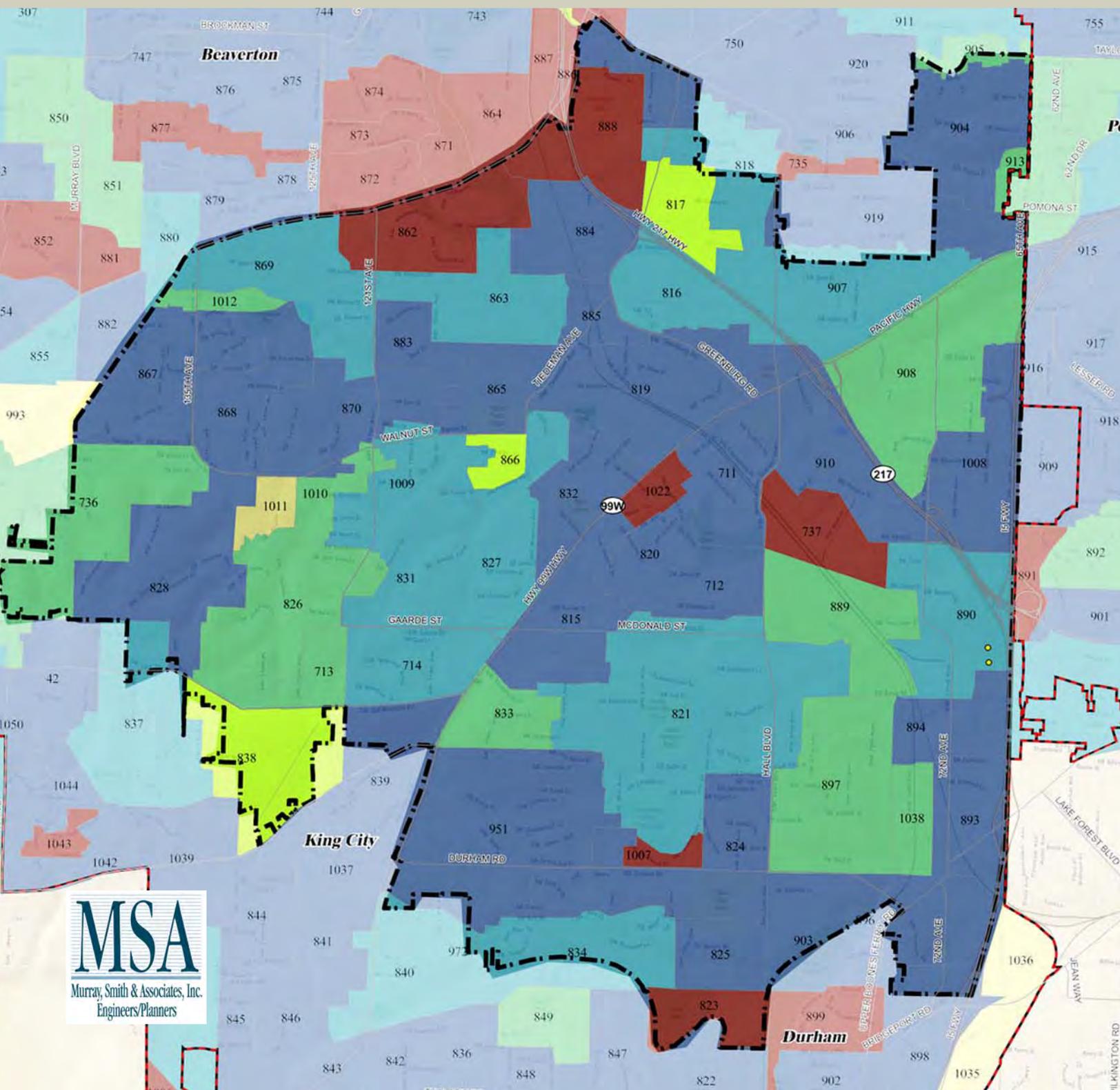




City of Tigard, Oregon

# Sanitary Sewer Master Plan Addendum

January 2014



## ACKNOWLEDGEMENTS

We would like to thank the many citizens, staff, and community groups who provided extensive input into the development of this Plan. Special thanks are due to the members of the River Terrace Technical Advisory Committee and Stakeholder Working Group.

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## **SUMMARY OF RECOMMENDATIONS**

The focus of this Sanitary Sewer Master Plan Addendum is on providing sewer service to the River Terrace Community, which is a new area that the City of Tigard's 2010 Sanitary Sewer Master Plan does not address. The only proposed change that affects the 2010 Sanitary Sewer Master Plan includes the recommendation to remove the Pleasant View and Meyers Farm pump stations from service following development of the River Terrace Community.

For the purposes of analysis, the River Terrace Community was split into two sub-basins identified as River Terrace North and River Terrace South. Recommendations for the River Terrace North sub-basin include a proposed pump station in the northwest corner of the area, north of the tributary natural resource corridor and adjacent to the western boundary of the current Urban Growth Boundary (UGB). Recommendations for the River Terrace South sub-basin include revising the service area for the existing South Bull Mountain Pump Station to serve part of the River Terrace Community as well as the construction of one proposed pump station within the sub-basin. A detailed analysis of sewer service recommendations as well as feasible alternatives is provided below.

## I. INTRODUCTION

In 2010, the City of Tigard updated the community's Sanitary Sewer Master Plan, hereafter referred to as the SSMP. The SSMP is the document that develops flows based on land use zoning and establishes gravity sewer pipe sizes, serving as a guide for all capital sewer projects within the city. The 2010 SSMP update was developed in concert with Clean Water Services (CWS), the agency responsible for all pump stations, wastewater treatment and large gravity sewer pipes (24-inch diameter and greater). The 2010 SSMP update, which did not address the River Terrace area, was adopted by the Tigard City Council on September 14, 2010.

Since the adoption of the SSMP update in 2010, the West Bull Mountain Concept Plan (WBMCP) was completed and adopted by Washington County and the city. The area now known as River Terrace (and formerly known as West Bull Mountain) was also annexed to the city. This addendum provides an update to the SSMP specific to the River Terrace study area, identified in Figures 1 and 2, and contributes to the city's broader goal of completing a River Terrace Community Plan.

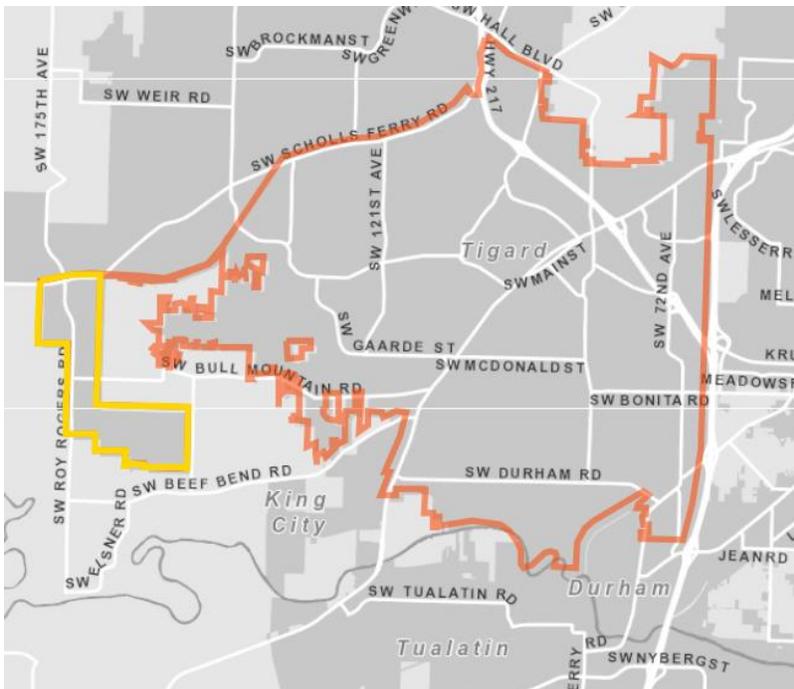


Figure 1 River Terrace Study Area (Outlined in Yellow)

The WBMCP wastewater element presented a description and comparison of two conceptual wastewater system infrastructure alternatives for the West Bull Mountain planning area. This SSMP Addendum refines the WBMCP, including an analysis of service alternatives for specific areas within the River Terrace area.

## II. BASIS OF PLANNING AND FLOW DEVELOPMENT

### **Basis of Planning**

All flows for the River Terrace Community were generated assuming full development in the UGB areas and build out development in the Urban Reserve Areas (URA), which follows the planning assumptions from the CWS Summary of Future Flow Generation, Rock Creek and Durham Sanitary Sewer Basins (CH2M Hill, 2013). Unit flow factors used to develop the average dry weather flow (ADWF) in the SSMP also match CWS land use-based flow factors.

Wet weather flows are developed by adding an infiltration and inflow (I/I) factor to the calculated dry weather, sanitary flows. The city's master plan identified an I/I flow factor of 1,650 gallons per acre per day (gpad) for currently undeveloped areas and applied a factor of 4,000 gpad for sizing trunk sewers. However, given the relatively large size of this growth area, using 4,000 gpad results in oversized sewer pipes. In an effort to coordinate with the CWS planning work, a single rate of 2,500 gpad was used for estimating the I/I flows as well as trunk sizing. This flow rate was applied to the gross UGB areas and 65 percent of the gross URAs. For smaller basin planning, the city and/or CWS may require facilities to be designed based on an I/I flow factor of 4,000 gpad.

### ***River Terrace Flow Development within the UGB***

This SSMP Addendum follows the 2010 Sanitary Sewer System Master Plan and assumes 2.4 persons per dwelling unit. The City of Tigard projects 2,587 dwelling units within the River Terrace Community by build out in 2035.

The River Terrace Community was divided into specific zoning areas by the city, including low to high residential densities, a commercial development in the north and a school in the south. The number of dwelling units per acre designated in each residential zone varies from 4.5 to 25 dwelling units/acre. An overview of the zoning layout for the UGB area is provided in Figure 3.

A flow per dwelling unit was developed based on the population density and the average unit capita flow factor. The 2010 Sanitary Sewer Master Plan uses an ADWF factor of approximately 180 gallons per day per dwelling unit (gpd/DU). This factor was calculated by taking the average unit capita flow factor for single and multi-family residents, approximately 75 gallons per capita per day (gpcd), and applying it to the population density of 2.4 persons per dwelling unit. This flow per dwelling unit is congruent with the CWS residential ADWF factors from the Summary of Future Flow Generation, Rock Creek and Durham Sanitary Sewer Basins document (CH2M Hill, 2013).

The ADWF for the residential areas was estimated by multiplying this flow factor by the total number of projected dwelling units by build-out.

For the commercial zone, the ADWF was calculated using the 2010 Sanitary Sewer Master Plan unit flow factor of 3,660 gpad. Since the 2010 Sanitary Sewer Master Plan did not include a unit flow factor for a school use, the school use ADWF was calculated using the CWS land use flow factors of 1,050 gpad. ADWF for the commercial zone and school use were estimated by multiplying the ADWF factor in gpad by the net area. To align with CWS planning, the net area was estimated by taking the gross area less the existing right-of-way (ROW), estimated at 5 percent of the gross area.

The 2010 Sanitary Sewer Master Plan uses an I/I flow factor of 4,000 gpad for project sizing and 1,650 gpad for modeling purposes. CWS current planning efforts assume an I/I flow of 2,500 gpad. To be consistent with CWS current efforts the I/I flow for the residential and commercial zones and school use were developed by applying the flow factor of 2,500 gpad to the gross area. The 20-acre lot that is designated for a proposed school is not identified on the proposed River Terrace Community zoning map, but was subtracted from the gross single and multi-family residential areas. Flows developed for the River Terrace Community within the UGB are provided in Table 1.

**Table 1  
River Terrace Flow Development within UGB**

<b>Zone</b>	<b>Gross Area (Acres)</b>	<b>Net Area (Acres)</b>	<b>Dwelling Units</b>	<b>ADWF Factor</b>	<b>ADWF<sup>(1)</sup> (mgd)</b>	<b>I/I Flow (mgd)</b>
Single and Multi-Family Residential	466.6	-	2,587	180 (gal/DU day)	0.47	1.17
Commercial	17.8	16.9	-	3,660 (gpad)	0.06	0.04
School	20.0	19.0	-	1,050 (gpad)	0.02	0.05

Note:

1. A peaking factor was not applied to the ADWF.

***River Terrace Flow Development within the Urban Reserve Areas 6C***

Estimation of the ADWF for the URAs, which are not currently zoned for development, was based on the values for the CWS land use class designation of Exclusive Farm or Forest Use (EFU) with an ADWF factor of 1,750 gpad. The 2010 Sanitary Sewer Master Plan did not include an ADWF factor for this land use designation. The ADWF was estimated by multiplying the land use flow factor by the net URA acreage. Net buildable acreage in the three URAs comply with CWS planning such that the net area is 65 percent of the gross area less the existing ROW, estimated at 5 percent of the gross area. I/I flows were developed by applying the CWS I/I flow factor of 2,500 gpad to 65 percent of the gross area. Flows developed for the URAs 6C (North), (Middle) and (South) are provided in Table 2.

**Table 2  
River Terrace Flow Development within URAs**

<b>Zone</b>	<b>Gross Area (Acres)</b>	<b>Net Area (Acres)</b>	<b>ADWF Factor (gpad)</b>	<b>ADWF<sup>(1)</sup> (mgd)</b>	<b>I/I Flow (mgd)</b>
URA 6C (North)	140.0	86.5	1,750	0.2	0.2
URA 6C (Middle)	162.5	100.3	1,750	0.2	0.3
URA 6C (South)	205.0	126.6	1,750	0.2	0.3

Note:

1. A peaking factor was not applied to the ADWF.

### **III. HYDRAULIC MODEL**

The Durham hydraulic model previously completed by CWS incorporated all of the above information to provide an analysis of the capacity of the existing system and impacts from the new River Terrace Community. Discharging flows to the north from the River Terrace Community routes flows through the CWS Fanno Interceptor while discharging flows to the south from the River Terrace Community sends flows through the Upper Tualatin Interceptor.

Modeling results confirmed known capacity limitations in the Barrows Road trunk to the north, which established a practical limitation on the flow through that pipeline. The flow modeling and recommendations associated with this planning effort closely aligns with CWS plans for directing flows.

### **IV. SYSTEM ALTERNATIVES EVALUATION**

#### **River Terrace Sub-Basin Service Delineation Alternatives**

The River Terrace Community is naturally divided into two areas, one draining to the north and one draining to the south. Splitting the area into two sub-basins to follow the existing terrain is necessary to avoid excessively deep sewers. The two sub-basins are designated as River Terrace North (RTN) and River Terrace South (RTS). Two delineation alternatives to separate the north and south sub-basins were evaluated.

- Alternative 1 separates the sub-basins along SW Bull Mountain Road.
- Alternative 2 separates the areas at the ridge south of SW Bull Mountain Road.

The main differences between the two alternatives include average pipe depths and lengths. The first alternative includes an average pipe depth of 10 feet for approximately 4,000 linear feet (LF) while the second alternative includes an average pipe depth of 30 feet for approximately 6,000 LF. The additional area from Alternative 2 (bounded by SW Bull Mountain Rd and the ridge to the south) does not drive additional pipe depths to the RTS sub-basin. A comparison of the two delineation alternatives is shown in Figure 4.

### ***Recommendation: River Terrace Sub-Basin Service Delineation***

It is recommended that the River Terrace Community be divided along SW Bull Mountain Road (Alternative 1) since the average pipe depth and lengths are more practical compared to the depth and lengths from Alternative 2.

### **River Terrace Sub-Basin Sewer Service Alternatives**

This service evaluation assumes that infrastructure will be contained within the existing UGB area. Gaining approval to locate infrastructure in URA lands, outside of the current UGB, requires the service provider to demonstrate to Washington County that:

1. The service cannot be provided from within the UGB, and
2. It does not affect the existing land use purpose.

Underground pipes outside the UGB have been successfully permitted in the past, though the process is somewhat longer, but a pump station outside the UGB has yet to be permitted.

All sewer service alternatives discussed for the River Terrace North and South sub-basins will adhere to previously recommended alternatives discussed in this addendum. Sewer service provided for the URAs 6C (North), (Middle) and (South) will be discussed later in this addendum.

To route the gravity sewer lines within the River Terrace North and South sub-basins, different aspects regarding the existing area were taken into consideration. These criteria include: existing and proposed roads, protected natural resource areas (e.g. natural resource corridors), potential development and pipe depth.

### ***River Terrace North Sub-Basin***

The majority of the RTN sub-basin cannot be drained by gravity sewer lines into an existing trunk sewer due to the topography sloping away from existing sewer trunk lines. The exception is a small area of land immediately south of Scholls Ferry Road and Barrows Road. This area will drain by gravity via an existing 12-inch stub to the 21-inch pipe recently installed in Scholls Ferry Road, which was sized to accommodate build-out flows from RTN, the City of Beaverton's South Cooper Mountain area, and URA lands. The existing 8-inch pipe further to the east in SW Barrows Rd has been identified by CWS to require upsizing to accommodate build-out flows from RTN, the City of Beaverton's South Cooper Mountain area, and URA lands.

Due to topography, the rest of the RTN sub-basin must be served by a pump station located along the western boundary of the UGB at the natural low point of the service area. Three proposed gravity sewer lines are identified to provide service to the sub-basin. The projected flows for each of these trunks are provided in Table 3.

**Table 3  
River Terrace North Sub-Basin Flow Development Summary**

	<b>Gross Area (Acres)</b>	<b>Dwelling Units</b>	<b>ADWF (mgd)</b>	<b>I/I Flow (mgd)</b>	<b>PWWF<sup>(1)</sup> (mgd)</b>
Gravity Segment 1	37.3	216	0.04	0.09	0.22
Gravity Segment 2	99.8	542	0.16	0.25	0.78
Gravity Segment 3 <sup>(2)</sup>	199.9	1,135	0.27	0.50	1.62
Gravity Segment 4	80.7	505	0.09	0.20	0.50
Gravity Segment 5	43.1	147	0.03	0.11	0.43 <sup>(3)</sup>
Scholls Cntry Est PS <sup>(4)</sup>	-	-	-	-	0.24

Note:

1. Peak factor of 3.3, from ASCE's Peak Factor vs. Average Flow graph applied to the ADWF. Peak Wet Weather Flow (PWWF) taken from the sum of the peak ADWF and I/I flow.
2. Gravity Segment 3 values are representative of the entire River Terrace North sub-basin, less the area within the River Terrace North sub-basin draining to Barrows Rd Trunk.
3. Includes flow from Scholls Country Estates pump station
4. Scholls Country Estates Pump Station build out peak wet weather flows from the Siting Study for River Terrace Pump Stations and Force Mains Report for CWS (MSA, 2013).

Two low points were identified in the sub-basin along the UGB boundary, one to the north of the creek tributary and one to the south. However, after further analysis, the location to the south of the tributary results in the pump station and trunk sewers being slightly deeper. Additionally, the location south of the tributary does not allow the pump station to serve the City of Beaverton's South Cooper Mountain area, which is necessary per the CWS Sewer Master Plan.

As development occurs, the Scholls Country Estates pump station will be taken offline and its existing service area will flow by gravity into the RTN Pump Station (PS). A proposed force main will be routed northward along existing and proposed right-of-way, where possible, to discharge into an existing manhole at Scholls Ferry Road. A detailed layout of the RTN proposed sewer service is shown in Figure 5.

Flows from both the RTN area and the City of Beaverton are anticipated to drain to the RTN PS, resulting in a large increase from initial flows to build out flows. To accommodate this growth, the sizing of the proposed pump station equipment and facility will be phased. The initial phase will include construction of the primary facility components to provide service for the projected build out flows, but pumping equipment will be sized for initial flow conditions. This approach avoids oversized equipment, which is problematic from an operational standpoint, and minimizes the construction efforts associated with future capacity expansions. The future phase will include build out conditions and equipment for flows from additional areas such as the URA 6C (North) and flows from Scholls Country Estates PS. Upon completion of the RTN PS, gravity sewer lines from the City of Beaverton and Scholls Country Estates PS will lead to this pump station.

Table 4 provides an understanding of pipe size relative to full capacity and minimum slope. This table was used to determine gravity sewer line sizes based on capacity for both the River Terrace North and South sub-basin alternatives. Table 5 provides conceptual cost estimates for the RTN proposed sewer service.

**Table 4  
Pipe Size and Capacity**

Size (in.)	Minimum Slope (ft/100 ft)	Capacity (gpm)	Capacity (mgd)
8	0.40	344	0.5
10	0.28	522	0.8
12	0.22	752	1.1
15	0.15	1,126	1.6
18	0.12	1,638	2.4
21	0.10	2,255	3.3
24	0.08	2,880	4.2

***Recommendation: River Terrace North Sub-Basin***

Based on information currently available, it is recommended that a single pump station be located north of the natural resource corridor and along the western edge of the UGB. As the design is further developed and additional data becomes available, such as geotechnical borings, depth of rock may drive an alternate location or potentially render a single pump station infeasible.

**Table 5  
River Terrace North Service Alternatives Cost Estimates**

	<b>Depth (ft)</b>	<b>Length (LF)</b>	<b>Flow<sup>(1)</sup> (gpm)</b>	<b>Size<sup>(2)</sup> (in.)</b>	<b>Cost/LF</b>	<b>Total Cost<sup>(6)</sup></b>
Gravity Segment 1	10	1,300	154	8	\$138 <sup>(3)</sup>	\$180,000 <sup>(4)</sup>
Gravity Segment 2	10	1,700	539	12	\$167 <sup>(3)</sup>	\$305,000 <sup>(4)</sup>
Gravity Segment 3	10	900	1,124	15	\$189 <sup>(3)</sup>	\$178,000 <sup>(4)</sup>
Gravity Segment 4	10	1,000	348	10	\$152 <sup>(3)</sup>	\$170,000 <sup>(4)</sup>
Gravity Segment 5	10	1,600	302	8	\$138 <sup>(3)</sup>	\$229,000 <sup>(4)</sup>
Force Main	-	2,000	1,124	12	\$150	\$314,000 <sup>(4)</sup>
Pump Station	-	-	8.6 <sup>(5)</sup> mgd	-	-	\$3,487,000 <sup>(6)</sup>
Scholls Ferry Trunk Extension	-	-	-	-	-	\$942,000 <sup>(7)</sup>
Barrows Rd Trunk Upsizing	-	-	-	-	-	\$170,000 <sup>(8)</sup>
<b>Construction Sub-Total</b>						<b>\$5,974,000</b>
Engineering Legal and Administrative (ELA) costs, 25 percent allowance Construction Sub-Total Costs						\$1,494,000
<b>Construction and ELA Sub-Total</b>						<b>\$7,468,000</b>
30 percent contingency of ELA costs						\$2,240,000
<b>Total Cost</b>						<b>\$9,708,000</b>

Note:

1. Peak factor of 3.3, from ASCE's Peak Factor vs. Average Flow graph applied to the ADWF. Peak Wet Weather Flow (PWWF) taken from the sum of the peak ADWF and I/I flow.
2. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
3. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014.
4. No easement costs added to gravity segments and force main sewer lines within existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
5. Capacity of pump station based on build out flows, with 7 mgd of build out flow from the City of Beaverton.
6. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.
7. This cost is the City of Tigard's budgeted share for the installation of this pipe.
8. This cost is the City of Tigard's estimated share for the upsizing of this pipe.

### ***River Terrace South Sub-Basin***

Due to multiple natural resource corridor areas dividing the RTS sub-basin, the sub-basin was split into five sub-areas for analysis. A detailed layout of the RTS sub-areas is shown in Figure 6. A summary of ADWF, I/I flows and PWWF for the RTS sub-areas are provided in Table 6. Descriptions and analysis relative to alternatives to serve these five sub-areas are outlined below.

**Table 6  
River Terrace South Sub-Areas Flow Development Summary**

River Terrace South Sub-Areas	Gross Area (Acres)	Dwelling Units	ADWF (mgd)	I/I Flow (mgd)	PWWF <sup>(1)</sup> (mgd)
1	41.6	168	0.03	0.10	0.2
2	85.2	389	0.07	0.21	0.4
3	11.2	28	0.01	0.03	0.1
4 <sup>(2)</sup>	52.8	161	0.05	0.13	0.3
5	100.4	603	0.11	0.25	0.6
Pleasant View PS <sup>(2)</sup>	-	-	-	-	0.5 <sup>(3)</sup>
Meyers Farm PS <sup>(3)</sup>	-	-	-	-	0.3 <sup>(4)</sup>

Note:

1. Peak factor of 3.3, from ASCE's Peak Factor vs. Average Flow graph applied to the ADWF. Peak Wet Weather Flow (PWWF) taken from the sum of the peak ADWF and I/I flow.
2. River Terrace South Sub-Area 4 includes the 20 acre designated school lot.
3. Pleasant View Pump Station build out peak wet weather flows from the Siting Study for River Terrace Pump Stations and Force Mains Report for CWS (MSA, 2013).
4. Meyers Farm Pump Station build out peak wet weather flows from the Siting Study for River Terrace Pump Stations and Force Mains Report for CWS (MSA, 2013).

*Alternatives for Sub-Areas 1 and 2*

The South Bull Mountain PS currently serves approximately 300 acres east of the RTS sub-basin situated north of SW Beef Bend Road and east of SW 150th Avenue. The South Bull Mountain PS has a maximum capacity of 2.4 MGD yet currently serves a peak flow of only 1.2 MGD. To maximize the existing capacity of this pump station, a portion of the RTS sub-basin, specifically RTS sub-areas 1 and 2, can potentially be served by this pump station.

In doing so, this will create capacity issues in the South Bull Mountain PS. Expanding the capacity of the South Bull Mountain PS is not considered practical due to its small existing footprint, surrounding sensitive environmental considerations, and somewhat challenging access to the adjacent SW Beef Bend Road. Thus two feasible alternatives were evaluated to alleviate this capacity issue.

- Alternative 1 sends flows from Pleasant View PS that currently routes to the South Bull Mountain PS, to the new RTS sub-area 4.
- Alternative 2 sends both flows from Pleasant View PS and Meyers Farm PS that currently route to the South Bull Mountain PS, to the new RTS sub-areas 4 and 5 respectively.

A comparison of the remaining capacity of South Bull Mountain PS is provided in the following table.

**Table 7  
Remaining Capacity of South Bull Mountain Pump Station  
Based on Peak Wet Weather Flows**

Area	PWWF (mgd)	Cumulative PWWF (mgd)	Remaining Capacity S. Bull Mountain Pump Station <sup>(1)</sup> (mgd)
1	0.2	0.2	1.0
2	0.4	0.6	0.6
Pleasant View PS <sup>(2)</sup>	0.5	1.1	0.1
Meyers Farm PS <sup>(3)</sup>	0.3	1.4	-0.2

Note:

1. South Bull Mountain PS allowing approximately 1.2 mgd of additional peak flow.
2. Pleasant View Pump Station build out peak wet weather flows from the Siting Study for River Terrace Pump Stations and Force Mains Report for CWS (MSA, 2013).
3. Meyers Farm Pump Station build out peak wet weather flows from the Siting Study for River Terrace Pump Stations and Force Mains Report for CWS (MSA, 2013).

An 8-inch sewer line approximately 2,000 LF exists at the southeast corner of the RTS sub-basin, allowing for immediate sewer service to sub-areas 1 and 2. However, the 8-inch sewer line located in SW Beef Bend Road just west of the South Bull Mountain PS establishes the hydraulic limitation. This sewer line has an existing peak flow of approximately 50 gallons per minute (gpm) based on the model, while having a capacity of roughly 250 gpm at full pipe capacity. Therefore, this sewer line can only accommodate approximately 200 gpm of additional flow. Peak flows were calculated for RTS sub-areas 1 and 2 to better understand how the capacity in the 8-inch sewer line along SW Beef Bend Road limits the area that can be served without driving a pipe size increase. The flows calculated are provided in the table below.

**Table 8  
Remaining Capacity of 8-inch Sewer Line Based on Peak Wet Weather Flows**

Sub-area	Gross Area (Acres)	Dwelling Units	ADWF (gpm)	I/I Flows (gpm)	PWWF <sup>(1)</sup> (gpm)	Remaining Capacity 8-inch sewer line <sup>(2)</sup> (gpm)
1	41.6	168	21	72	142	58
2	85.2	389	49	148	308	-108
1 and 2	126.8	557	70	220	450	-250

Note:

1. Peak factor of 3.3, from ASCE's Peak Factor vs. Average Flow graph applied to the ADWF. Peak Wet Weather Flow (PWWF) taken from the sum of the peak ADWF and I/I flow.
2. 8-inch sewer line along SW Beef Bend Road allowing 200 gpm of additional peak flow. Capacity based on full pipe flow.

Under current development, the 8-inch sewer line along SW Beef Bend Road can only accommodate RTS sub-area 1. Given this information, there are two feasible sub-alternatives to consider.

- Alternative 2a would be to leave the 8-inch sewer line along SW Beef Bend Road as is and only have flows from RTS sub-area 1 route to South Bull Mountain PS. Flows from RTS sub-area 2 will then have to route to the west of the RTS sub-basin.
- Alternative 2b would be to increase the capacity of the 8-inch sewer line to accommodate additional flows from both RTS sub-areas 1 and 2 to eventually lead to South Bull Mountain PS. The pipeline hydraulic capacity will need to be increased by approximately 220 gpm to flow at full capacity.

### ***Recommendation: River Terrace South Sub-Areas 1 and 2***

It is recommended that the South Bull Mountain PS serve RTS sub-areas 1 and 2 while flows from both Pleasant View and Meyers Farm PS flow to RTS sub-areas 4 and 5 respectively. This approach also allows for some development within the existing South Bull Mountain service area without requiring changes to the existing South Bull Mountain PS.

### ***Alternatives for Sub-Areas 3, 4 and 5***

The remaining sub-areas to be served within the RTS sub-basin, sub-areas 3, 4 and 5, cannot be feasibly served by gravity as the topography slopes away from the existing sewer system, which also does not have adequate capacity. To provide service to the remaining RTS sub-areas, two feasible alternatives were evaluated.

- The first alternative (identified as RTS-1) would be to construct one pump station in the southwest corner of sub-area 5. This location requires approximately 2,000 LF of sewer pipe from the southwest corner of sub-area 5 to the southwest corner of sub-area 4 at an average depth of 20 feet, with a maximum depth of approximately 40 feet.
- The second alternative (identified as RTS-2) would be to construct two pump stations, one in the southwest corner of sub-area 5 and one in the southwest corner of sub-area 4. This location requires approximately 1,000 LF of sewer pipe from the east corner of sub-area 5 to the west corner of sub-area 5 at an average depth of 10 feet. This alternative also requires an additional force main approximately 700 LF from the southwest corner of sub-area 4 to the east corner of sub-area 5.

In both alternatives, a force main will be routed south along Roy Rogers Road and east along Beef Bend Road past the South Bull Mountain PS. This route is preferred due to its ease of access and no intermediate high points, which create operational challenges.

The comparison of alternatives RTS-1 and RTS-2 is shown in Figure 7. A comparison of alternatives RTS-1 and RTS-2 conceptual level cost estimates are provided in Tables 9, 10A and 10B.

**Table 9  
RTS-1 and RTS-2 Common Gravity Line Segment Cost Estimates**

<b>RTS-1 and RTS-2 Common Segments</b>	<b>Depth (ft.)</b>	<b>Length (LF)</b>	<b>Flow (gpm)</b>	<b>Size<sup>(1)</sup> (in.)</b>	<b>Cost/LF</b>	<b>Total Cost<sup>(4)</sup></b>
Gravity Segment 1	10	600	326	8	\$138 <sup>(2)</sup>	\$98,000 <sup>(3)</sup>
Gravity Segment 2	10	700	31	8	\$138 <sup>(2)</sup>	\$115,000 <sup>(3)</sup>
Gravity Segment 3	10	1,700	358	10	\$152 <sup>(2)</sup>	\$301,000 <sup>(3)</sup>
Gravity Segment 4	15	1,800	101	8	\$167 <sup>(2)</sup>	\$317,000 <sup>(3)</sup>
Gravity Segment 5	10	400	236	8	\$138 <sup>(2)</sup>	\$66,000 <sup>(3)</sup>
Gravity Segment 6	17	900	338	10	\$182 <sup>(2)</sup>	\$187,000 <sup>(3)</sup>
Gravity Segment 7	25	1,000	550	12	\$721 <sup>(2)</sup>	\$722,000 <sup>(3)</sup>
Pump Station 1 Force Main	-	10,100	1,220	12	\$150	\$1,515,000 <sup>(3)</sup>

Note:

1. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
2. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014. 20% contingency added to Cost/LF for gravity segments with depths greater than 10' for underground rock encounters.
3. No easement costs added to gravity segments and force main sewer lines within existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
4. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.

**Table 10A  
RTS-1 Cost Estimates**

	<b>Depth (ft.)</b>	<b>Length (LF)</b>	<b>Flow (gpm)</b>	<b>Size<sup>(1)</sup> (in.)</b>	<b>Cost/LF</b>	<b>Total Cost<sup>(5)</sup></b>
Gravity Segment 8A	20	1,700	561	12	\$238 <sup>(2)</sup>	\$430,000 <sup>(3)</sup>
Gravity Segment 9A	20	1,000	671	12	\$238 <sup>(2)</sup>	\$264,000 <sup>(3)</sup>
Pump Station 1	-	-	1.8 mgd	-	-	\$832,000 <sup>(5)</sup>
Construction Sub-Total <sup>(4)</sup>						\$4,847,000
Engineering Legal and Administrative (ELA) costs, 25% allowance of Construction Sub-Total Costs						\$1,212,000
Construction and ELA Sub-Total						\$6,059,000
30% contingency of ELA costs						\$1,818,000
<b>Total Cost</b>						<b>\$7,877,000</b>

Note:

1. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
2. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014.
3. No easement costs added to gravity segments and force main sewer lines with existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
4. Construction sub-total includes sub-total of common segments from Table 9.
5. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.

**Table 10B  
RTS-2 Cost Estimates**

	Depth (ft.)	Length (LF)	Flow (gpm)	Size <sup>(1)</sup> (in.)	Cost/LF	Total Cost <sup>(4)</sup>
Gravity Segment 8B	12	1,000	561	12	\$180 <sup>(2)</sup>	\$205,000 <sup>(3)</sup>
Gravity Segment 9B	10	1,000	671	12	\$167 <sup>(2)</sup>	\$193,000 <sup>(3)</sup>
Pump Station 2 Force Main	-	700	561	12	\$150	\$105,000 <sup>(3)</sup>
Pump Station 1	-	-	1 mgd	-	-	\$486,000 <sup>(4)</sup>
Pump Station 2	-	-	0.8mgd	-	-	\$396,000 <sup>(4)</sup>
Construction Sub-Total <sup>(5)</sup>						\$4,706,000
Engineering Legal and Administrative (ELA) costs, 25 percent allowance of Construction Sub-Total Costs						\$1,177,000
Construction and ELA Sub-Total						\$5,883,000
30 percent contingency of ELA costs						\$1,765,000
<b>Total Cost</b>						<b>\$7,648,000</b>

Note:

1. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
2. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014.
3. No easement costs added to gravity segments and force main sewer lines with existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
4. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.
5. Construction sub-total includes sub-total of common segments from Table 9.

***Recommendation: River Terrace South Sub-Areas 3, 4 and 5***

Construction of a single pump station, as described in Alternative RTS-1, is recommended due to system operational benefits of not having to double-pump wastewater, requiring additional power. Additionally, labor hours and maintenance costs are significantly reduced by minimizing the number of pump stations.

**Urban Reserve Area Sewer Service Recommendations**

Service provided for the URAs 6C (North), 6C (Middle) and 6C (South) assumes the construction of the recommended alternatives for the River Terrace North and South sub-basin are complete. A description of the sewer service recommendations for the URAs are presented below.

- URA 6C (North) can largely be served by the pump station within the RTN sub-basin. One small area along the western edge that is separated by a ravine will require a small pump station in order to provide sewer service.
- URA 6C (Middle) can be served by a proposed pump station in the southwest corner of the area. This pump station can connect to the existing sewer line along the west

boundary of RTS sub-area 5 through a force main, which may be up to 12 inches in diameter. This planned approach slightly increased the size of the gravity line segments within the RTS sub-area 5, specifically gravity segment 7, from a 12-inch line to a 15-inch line. Alternatively, the flow from this area could potentially route to the north depending on development sequencing.

- URA 6C (South) can be served by a proposed pump station in the southwest corner of the area. The existing 12-inch gravity line (segment 7), running north to south within RTS sub-area 5, can be extended further south to tie into the new URA 6C (South) PS so that the existing PS in RTS sub-area 5 can be taken offline. This extended gravity line would then increase from a 12-inch to a 15-inch gravity sewer line. The URA 6C (South) PS would discharge through a force main, bypassing the existing 8-inch line along SW Beef Bend Road and continuing beyond South Bull Mountain PS to 137th Avenue where there is adequate capacity.

An overview of the recommendations for serving URAs 6C (North), 6C (Middle) and 6C (South) is shown in Figure 8.

## **V. CAPITAL IMPROVEMENT PLAN**

### **Summary of Recommendations and Conceptual Level Costs**

The recommended improvements for the River Terrace Community are shown in Figure 9. Proposed improvements for the River Terrace North and South sub-basins are discussed in the following section.

#### ***River Terrace North Sub-Basin***

It is recommended that the RTN sub-basin be served by one pump station as shown in Figure 9. This pump station should be located to the north of the tributary to avoid deep sewer lines, provide a feasible location to serve URA 6C (North) in the future, and serve the South Cooper Mountain Annexation Area within the City of Beaverton to the north. It is also recommended that the Scholls Country Estates PS to the northeast of the sub-basin be taken offline as development occurs in the RTN sub-basin. The capacity of the pump station and pipe sizes are based on build out flows from the RTN sub-basin, URA 6C (North), Scholls Country Estates PS and the City of Beaverton. A layout of the recommended service for the area as well as the entire River Terrace Community is shown in Figure 9. Conceptual level cost estimates for the recommended alternatives are provided in Table 11.

**Table 11  
River Terrace North Sub-Basin Recommended Service Cost Estimate**

	Depth (ft)	Length (LF)	Flow (gpm)	Size <sup>(1)</sup> (in.)	Cost/LF	Total Cost <sup>(5)</sup>
Gravity Segment 1	10	1,300	154	8	\$138 <sup>(2)</sup>	\$180,000 <sup>(3)</sup>
Gravity Segment 2	10	1,700	405	10	\$152 <sup>(2)</sup>	\$278,000 <sup>(3)</sup>
Gravity Segment 3	10	900	1,124	15	\$189 <sup>(2)</sup>	\$178,000 <sup>(3)</sup>
Gravity Segment 4	10	1,000	348	10	\$152 <sup>(2)</sup>	\$170,000 <sup>(3)</sup>
Gravity Segment 5	10	1,600	302	8	\$138 <sup>(2)</sup>	\$229,000 <sup>(3)</sup>
Force Main	-	2,000	1,597	12	\$150	\$314,000 <sup>(3)</sup>
Pump Station	-	-	9.3 <sup>(4)</sup> mgd	-	-	\$3,746,000 <sup>(5)</sup>
Construction Sub-Total						\$5,122,000
Engineering Legal and Administrative (ELA) costs, 25 percent allowance of Construction Sub-Total Costs						\$1,281,000
Construction and ELA Sub-Total						\$6,403,000
30 percent contingency of ELA costs						\$1,921,000
<b>Total Cost</b>						<b>\$8,324,000</b>

Note:

1. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
2. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014.
3. No easement costs added to gravity segments and force main sewer lines with existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
4. Capacity of pump station based on build out flows, with 7 mgd of build out flow from the City of Beaverton.
5. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.

### ***River Terrace South Sub-Basin***

It is recommended that a portion of the RTS sub-basin specifically RTS sub-areas 1 and 2, be served by the existing South Bull Mountain PS. It is also recommended that RTS sub-areas 3, 4 and 5 be served by a new pump station in the southwest corner of RTS sub-area 5. The Pleasant View PS and Meyers Farm PS should be taken offline upon development within RTS sub-areas 3, 4 or 5, and flows from these two pump stations should be routed through RTS sub-areas 4 and 5 respectively to the new pump station in sub-area 5. The capacity of the pump station and pipe sizes are based on build out flows from the RTS sub-basin area, Pleasant View PS, Meyers Farm PS and URA 6C (Middle). Gravity Segment 7 was sized to accommodate URA 6C (Middle) build out flows. A layout of the recommended service for the area as well as the entire River Terrace Community is shown in Figure 9. Conceptual level cost estimates for the recommended alternatives are provided in Table 12.

**Table 12**  
**River Terrace South Sub-Basin Recommended Service Cost Estimate**

	<b>Depth (ft.)</b>	<b>Length (LF)</b>	<b>Flow<sup>(1)</sup> (gpm)</b>	<b>Size<sup>(2)</sup> (in.)</b>	<b>Cost/LF</b>	<b>Total Cost<sup>(5)</sup></b>
Gravity Segment 1	10	600	326	8	\$138 <sup>(3)</sup>	\$98,000 <sup>(4)</sup>
Gravity Segment 2	10	700	31	8	\$138 <sup>(3)</sup>	\$115,000 <sup>(4)</sup>
Gravity Segment 3	10	1700	358	10	\$152 <sup>(3)</sup>	\$301,000 <sup>(4)</sup>
Gravity Segment 4	15	1800	101	8	\$167 <sup>(3)</sup>	\$317,000 <sup>(4)</sup>
Gravity Segment 5	10	400	236	8	\$138 <sup>(3)</sup>	\$66,000 <sup>(4)</sup>
Gravity Segment 6	17	900	338	8	\$182 <sup>(3)</sup>	\$187,000 <sup>(4)</sup>
Gravity Segment 7	25	1,000	1,099	15	\$749 <sup>(3)</sup>	\$750,000 <sup>(4)</sup>
Gravity Segment 8A	20	1,700	515	10	\$221 <sup>(3)</sup>	\$402,000 <sup>(4)</sup>
Gravity Segment 9A	20	1,000	625	12	\$238 <sup>(3)</sup>	\$264,000 <sup>(4)</sup>
Pump Station 1 Force Main	-	10,100	1,724	12	\$150	\$1,515,000 <sup>(4)</sup>
Pump Station 1	-	-	2.5 mgd	-	-	\$1,124,000
Construction Sub-Total						\$5,139,000
Engineering Legal and Administrative (ELA) costs, 25 percent allowance of Construction Sub-Total Costs						\$1,285,000
Construction and ELA Sub-Total						\$6,424,000
30 percent contingency of ELA costs						\$1,928,000
<b>Total Cost</b>						<b>\$8,352,000</b>

Note:

1. Peak factor of 3.3, from ASCE's Peak Factor vs. Average Flow graph applied to the ADWF. Peak Wet Weather Flow (PWWF) taken from the sum of the peak ADWF and I/I flow.
2. Size based on full pipe capacity and minimum slope from Table 4 of this memorandum.
3. Cost/LF from Appendix R of the 2009 Sanitary Sewer Master Plan Update CWS Table 1: Unit Costs for Gravity Sewers, \$/LF, ENR value for this table was 8602 from November 2008. Costs were scaled to reflect an ENR value of 9664 from January 2014.
4. No easement costs added to gravity segments and force main sewer lines with existing or proposed ROW. Easement assumed to be 20' wide with a cost of \$25/LF.
5. Costs reflect construction conditions typical of the area and do not include provisions for rock or other potential impacts, such as addressing significant groundwater.

CITY OF BEAVERTON

SW SCHOLLS FERRY RD

SW 15TH AVE

SW BARROWS RD

SW VANDERMOST RD

URBAN RESERVE 6C (NORTH)

RURAL RESERVE 5C

URBAN RESERVE 6C (MIDDLE)

SW ROY ROGERS RD

SW ROSHAK RD

SW 150TH AVE

SW BULL MOUNTAIN RD

UNDESIGNATED

SW BULL MOUNTAIN RD

SW WOODHUE ST

URBAN RESERVE 6C (SOUTH)

SW BEEF BEND RD

URBAN RESERVE 6D

**LEGEND**

- STUDY AREA
- PROPOSED RIGHT-OF-WAY
- TIGARD CITY LIMITS
- RIVER TERRACE COMMUNITY AREA
- URBAN RESERVE AREA
- 10' CONTOURS

C:\PDX\_Proj\csl\1484 - Tigard River Terrace\GIS\CITY OF TIGARD, FIGURES\SEWER SYSTEM\ADDENDUM\13-1484-OR-FIGURE 2 - STUDY AREA.mxd 4/18/2014 4:21:53 PM DKH

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SCALE IN FEET

SOURCE:  
CONTOURS - CLEAN WATER SERVICES.  
AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
ALL OTHER BASEMAPPING METRO/LRIS (AUG 2013).

**FIGURE 2**

CITY OF TIGARD  
RIVER TERRACE COMMUNITY PLAN  
RIVER TERRACE STUDY AREA

January 2014

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Engineers/Planners

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Portland, Oregon 97204-2919 FAX 503.235.9022

13-1484

**CITY OF BEAVERTON**

**URBAN RESERVE 6C (NORTH)**

**RURAL RESERVE 5C**

**URBAN RESERVE 6C (MIDDLE)**

**UNDESIGNATED**

**URBAN RESERVE 6C (SOUTH)**

**URBAN RESERVE 6D**

**LEGEND**

- RIVER TERRACE COMMUNITY STUDY AREA
- PROPOSED RIGHT-OF-WAY
- URBAN RESERVE AREA
- TIGARD CITY LIMITS

**ZONING:**

- COMMUNITY COMMERCIAL (CC)
- LOW DENSITY RESIDENTIAL (R-4.5)
- MEDIUM DENSITY RESIDENTIAL (R-7)
- MEDIUM-HIGH DENSITY RESIDENTIAL (R-12)
- HIGH DENSITY RESIDENTIAL (R-25)

0 1,000  
SCALE IN FEET

SOURCE:  
CONTOURS - CLEAN WATER SERVICES.  
AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
ALL OTHER BASEMAPPING METRO/LIS (AUG 2013).

**FIGURE 3**

**CITY OF TIGARD**  
RIVER TERRACE COMMUNITY PLAN  
RIVER TERRACE ZONE DESIGNATIONS

January 2014

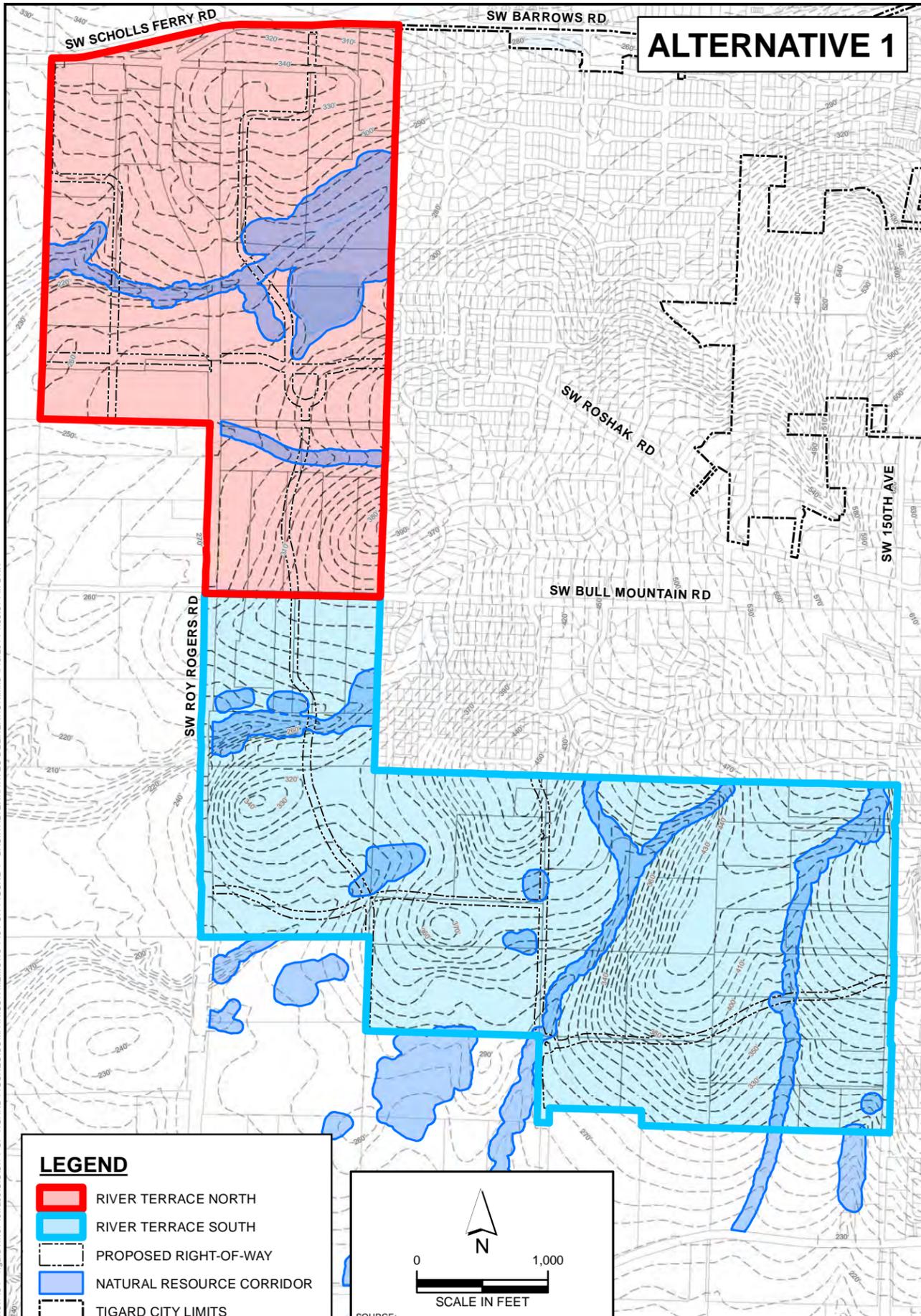
**MSA** Murray, Smith & Associates, Inc.  
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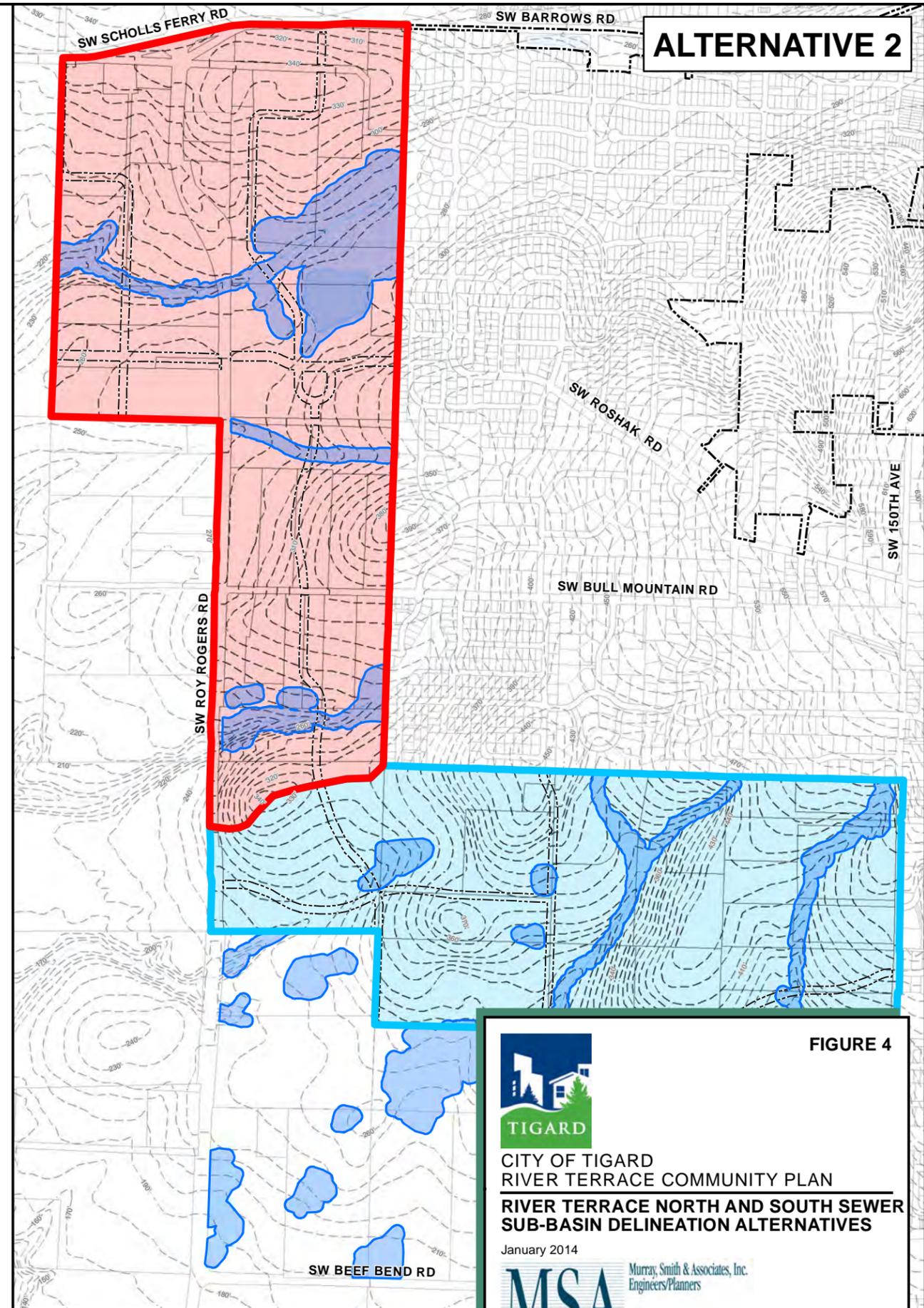
13-1484

C:\PDX\_Proj\GIS\City of Tigard River Terrace\GIS\CITY OF TIGARD, FIGURES\SEWER SYSTEM\ADDENDUM\3-1484-OR-FIGURE 3 - ZONING.mxd 4/18/2014 4:23:25 PM DKH

G:\PDX\_Projects\131484 - Tigard River Terrace\GIS\CITY OF TIGARD FIGURES\COMPARISON MEMO\131484-OR-FIGURE 4 - BASIN ALTERNATIVES DELINEATION.mxd 4/18/2014 4:33:31 PM DKH



# ALTERNATIVE 1



# ALTERNATIVE 2

**LEGEND**

- RIVER TERRACE NORTH
- RIVER TERRACE SOUTH
- PROPOSED RIGHT-OF-WAY
- NATURAL RESOURCE CORRIDOR
- TIGARD CITY LIMITS
- 10' CONTOURS

  
 0 1,000  
 SCALE IN FEET

SOURCE:  
 CONTOURS - CLEAN WATER SERVICES  
 AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
 WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
 ALL OTHER BASEMAPPING METRO/RLIS (AUG 2013).

**FIGURE 4**



**CITY OF TIGARD**  
 RIVER TERRACE COMMUNITY PLAN  
 RIVER TERRACE NORTH AND SOUTH SEWER  
 SUB-BASIN DELINEATION ALTERNATIVES

January 2014



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**LEGEND**

-  PROPOSED PUMP STATION
-  TRUNK LINE
-  FORCE MAIN
-  PROPOSED RIGHT-OF-WAY
-  NORTH SUB-BASIN SERVICE BOUNDARY
-  SEGMENT NUMBER
-  NATURAL RESOURCE CORRIDOR
-  RIVER TERRACE NORTH AREA
-  TIGARD CITY LIMITS
-  10' CONTOURS

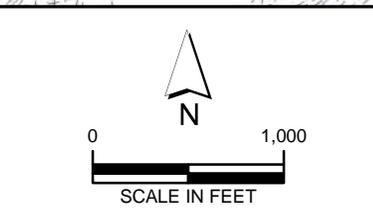
**RIVER TERRACE NORTH AREA  
TRIBUTARY TO SW SCHOLLS  
FERRY RD TO DRAIN TO  
BARROWS RD TRUNK**

**PROPOSED  
PUMP STATION**

**SCHOLLS COUNTRY  
ESTATES  
PUMP STATION**

**EXISTING SCHOLLS  
COUNTRY ESTATES  
PUMP STATION BASIN**

G:\PDX\_Projects\1311484 - Tigard River Terrace\GIS\CITY OF TIGARD\FIGURES\COMPARISON MEMO\1311484-OR-FIGURE 5 - COMPARISON MEMO RTN (8.5x11).mxd 4/21/2014 11:18:16 AM DKH



**SOURCE:**  
CONTOURS - CLEAN WATER SERVICES.  
AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
ALL OTHER BASEMAPPING METRO/LIS (AUG 2013).

**FIGURE 5**



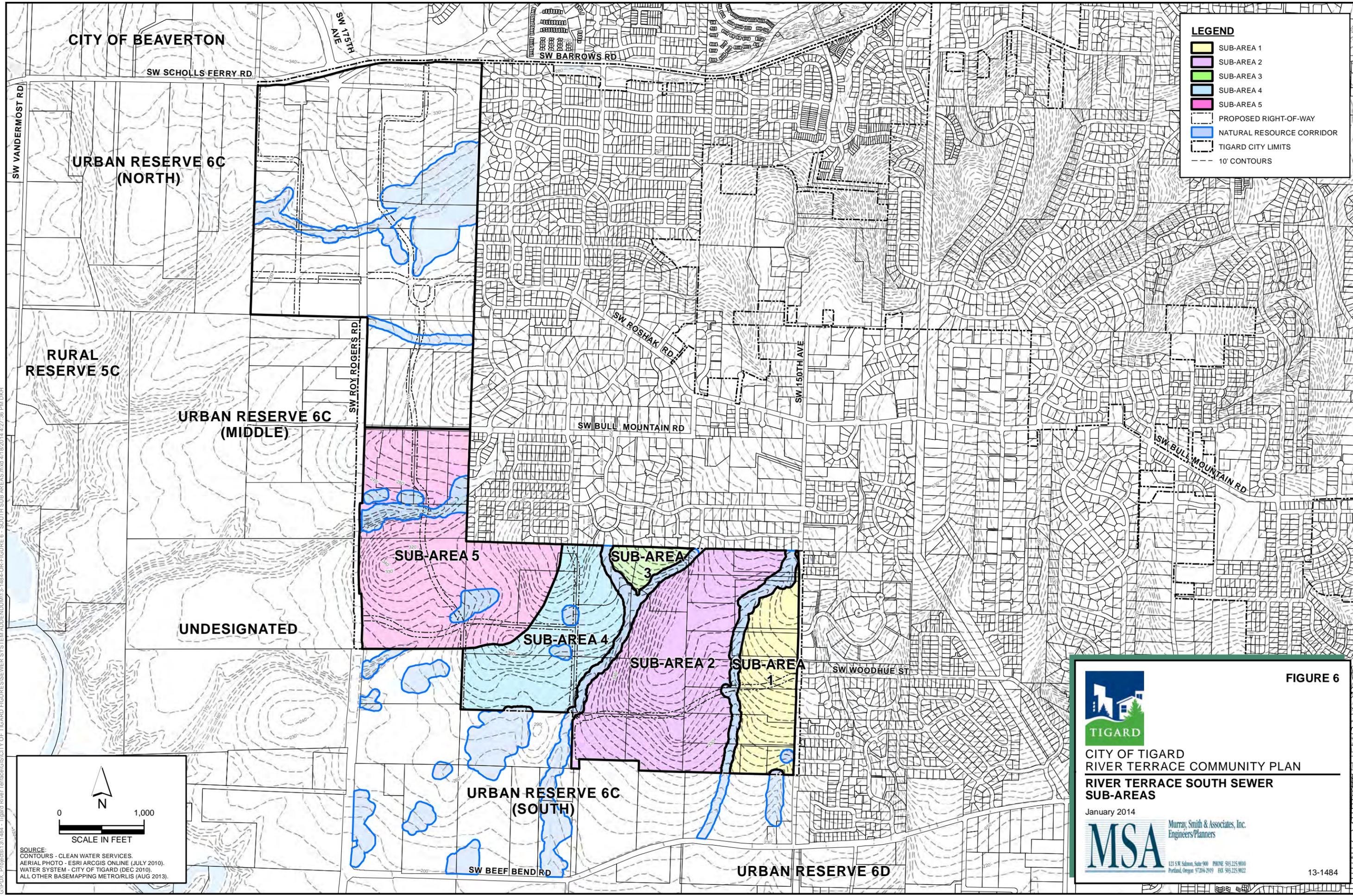
**CITY OF TIGARD  
RIVER TERRACE COMMUNITY PLAN  
RIVER TERRACE NORTH SUB-BASIN  
SEWER SERVICE**

January 2014



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**LEGEND**

- SUB-AREA 1
- SUB-AREA 2
- SUB-AREA 3
- SUB-AREA 4
- SUB-AREA 5
- PROPOSED RIGHT-OF-WAY
- NATURAL RESOURCE CORRIDOR
- TIGARD CITY LIMITS
- 10' CONTOURS

0 1,000  
SCALE IN FEET

  
 SOURCE:  
 CONTOURS - CLEAN WATER SERVICES.  
 AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
 WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
 ALL OTHER BASEMAPPING METRO/LR/LIS (AUG 2013).

**FIGURE 6**

  
**TIGARD**  
 CITY OF TIGARD  
 RIVER TERRACE COMMUNITY PLAN  
 RIVER TERRACE SOUTH SEWER  
 SUB-AREAS  
 January 2014

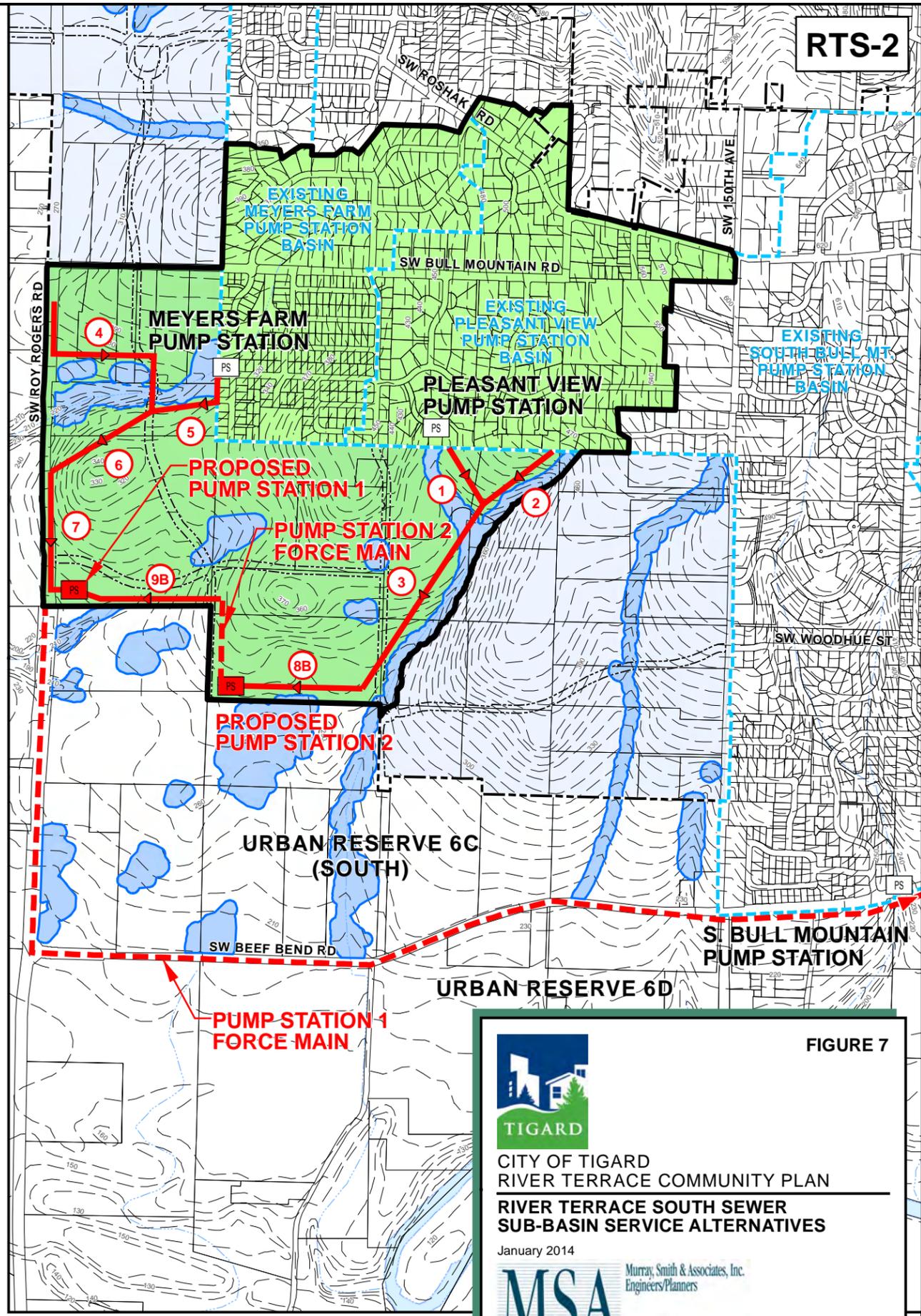
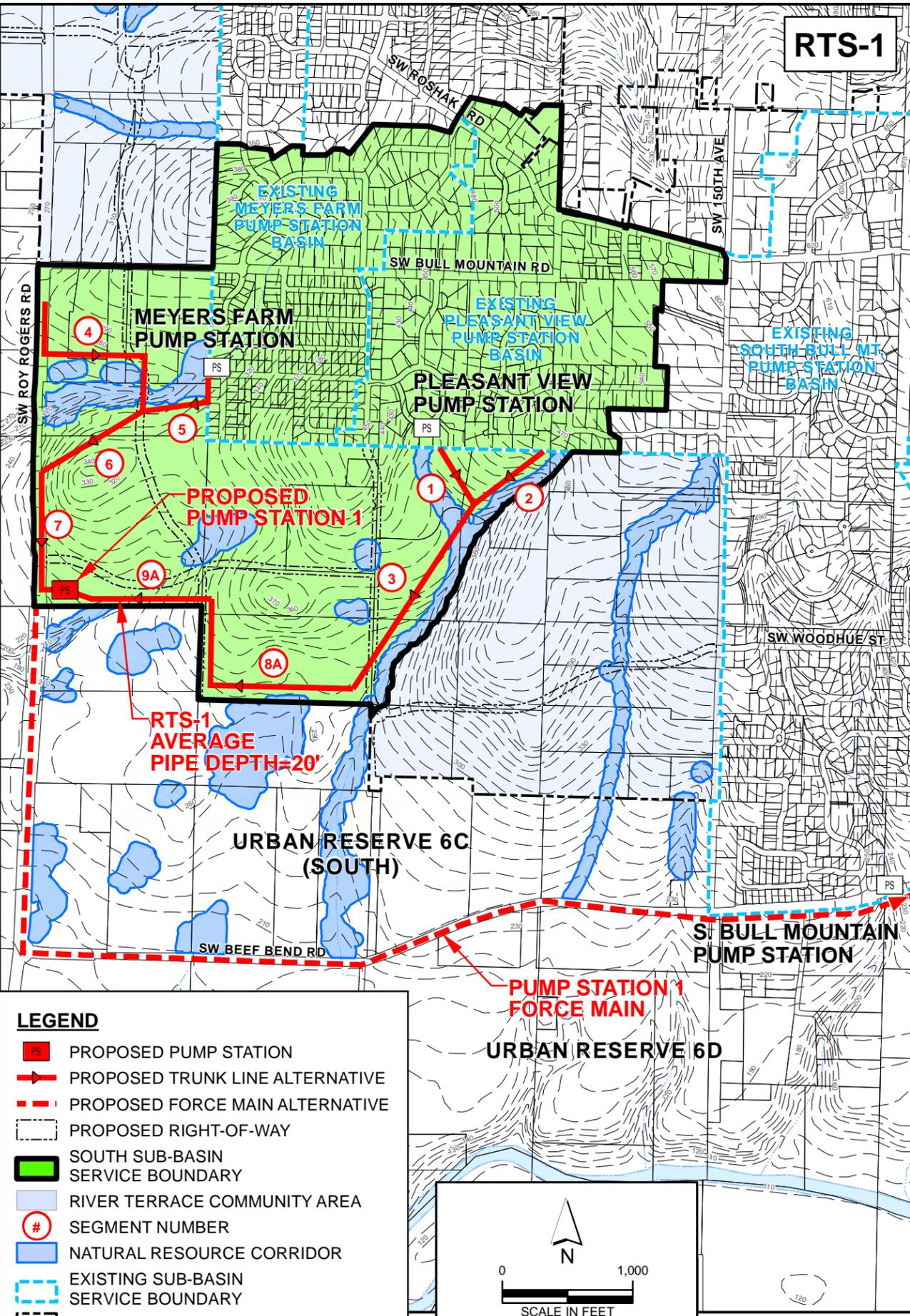
  
**MSA**  
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13-1484

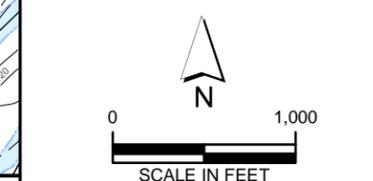
C:\PDX\_Proj\csl\131484 - Tigard River Terrace\GIS\CITY OF TIGARD, FIGURES\SEWER SYSTEM\ADDENDUM\13-1484-OR-FIGURE 6 - SOUTH SUB-AREAS.mxd, 4/18/2014, 4:27:36 PM DKH

RTS-1

RTS-2



- LEGEND**
- PS PROPOSED PUMP STATION
  - PROPOSED TRUNK LINE ALTERNATIVE
  - - - PROPOSED FORCE MAIN ALTERNATIVE
  - PROPOSED RIGHT-OF-WAY
  - SOUTH SUB-BASIN SERVICE BOUNDARY
  - RIVER TERRACE COMMUNITY AREA
  - # SEGMENT NUMBER
  - NATURAL RESOURCE CORRIDOR
  - EXISTING SUB-BASIN SERVICE BOUNDARY
  - TIGARD CITY LIMITS
  - 10' CONTOURS



SOURCE:  
 CONTOURS - CLEAN WATER SERVICES.  
 AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
 WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
 ALL OTHER BASEMAPPING METRO/RLIS (AUG 2013).

**FIGURE 7**



**CITY OF TIGARD**  
 RIVER TERRACE COMMUNITY PLAN  
 RIVER TERRACE SOUTH SEWER  
 SUB-BASIN SERVICE ALTERNATIVES  
 January 2014



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G:\PDX\_Projects\131484 - Tigard River Terrace\GIS\CITY OF TIGARD FIGURES\COMPARISON MEMO\131484-OR-FIGURE 7 - COMPARISON MEMO.RTS.mxd 4/21/2014 11:16:36 AM DKH

CITY OF BEAVERTON

SW SCHOLLS FERRY RD

SW 15TH AVE

SW BARROWS RD

AREA NOT SERVED BY REGIONAL FACILITY - WILL REQUIRE SEPARATE PUMP STATION

URBAN RESERVE 6C (NORTH)

RTN PUMP STATION

NO SEWER SERVICE AND/OR NO DEVELOPABLE LAND

URBAN RESERVE 6C (MIDDLE)

URA 6C (MIDDLE) PROPOSED PUMP STATION

FORCE MAIN TO RTS

PROPOSED PUMP STATION 1 REMOVED UPON URA 6C (SOUTH) DEVELOPMENT

EXTENDED GRAVITY LINE FROM RTS-1 PUMPSTATION

URA 6C (SOUTH) PROPOSED PUMP STATION

URBAN RESERVE 6C (SOUTH)

SW BEEF BEND RD

SW BULL MOUNTAIN RD

SW ROSHAK RD

SW 150TH AVE

SW WOODHUE ST

SW BULL MOUNTAIN RD

S. BULL MOUNTAIN PUMP STATION

**LEGEND**

- PS PROPOSED PUMP STATION URA 6C (MIDDLE)
- PS PROPOSED PUMP STATION URA 6C (SOUTH)
- - - PROPOSED FORCE MAIN URA 6C (MIDDLE)
- PROPOSED TRUNK URA 6C (SOUTH)
- PROPOSED RIGHT-OF-WAY
- URBAN RESERVE AREA
- DEVELOPED RIVER TERRACE COMMUNITY
- TIGARD CITY LIMITS
- 10' CONTOURS

C:\PDX\_Proj\csl\131484 - Tigard River Terrace\GIS\CITY OF TIGARD\_FIGURES\SEWER SYSTEM\ADDENDUM\13-1484-OR-FIGURE 8 - URA ALTERNATIVES.mxd 4/18/2014 4:28:51 PM DKH

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SCALE IN FEET

SOURCE:  
CONTOURS - CLEAN WATER SERVICES  
AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
ALL OTHER BASEMAPPING METRO/LIS (AUG 2013).

**FIGURE 8**



CITY OF TIGARD  
RIVER TERRACE COMMUNITY PLAN  
URBAN RESERVE AREA  
SEWER SERVICE ALTERNATIVES  
January 2014



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CITY OF BEAVERTON

URBAN RESERVE 6C (NORTH)

URBAN RESERVE 6C (MIDDLE)

URA 6C (MIDDLE) PROPOSED PUMP STATION

MEYERS FARM PUMP STATION

PLEASANT VIEW PUMP STATION

PROPOSED RTS PUMP STATION 1 REMOVED UPON URA 6C (SOUTH) DEVELOPMENT

URBAN RESERVE 6C (SOUTH)

URA 6C (SOUTH) PROPOSED PUMP STATION

RIVER TERRACE NORTH AREA TRIBUTARY TO SW SCHOLLS FERRY RD TO DRAIN TO BARROW RD TRUNK

SCHOLLS COUNTRY ESTATES PUMP STATION

SCALE IN FEET

SOURCE:  
CONTOURS - CLEAN WATER SERVICES.  
AERIAL PHOTO - ESRI ARCGIS ONLINE (JULY 2010).  
WATER SYSTEM - CITY OF TIGARD (DEC 2010).  
ALL OTHER BASEMAPPING METROLIS (AUG 2013).

**LEGEND**

- PROPOSED PUMP STATION
- PROPOSED TRUNK LINE ALTERNATIVE
- PROPOSED FORCE MAIN ALTERNATIVE
- EXISTING PUMP STATION
- PROPOSED RIGHT-OF-WAY
- RIVER TERRACE NORTH
- RIVER TERRACE SOUTH
- URBAN RESERVE AREA
- NATURAL RESOURCE CORRIDOR
- TIGARD CITY LIMITS
- 10' CONTOURS

**FIGURE 9**

CITY OF TIGARD  
RIVER TERRACE COMMUNITY PLAN  
PROPOSED SEWER SERVICE

January 2014

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13-1484

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