5 Alternative Evaluation

This section provides an overview of the methodology used to develop the recommended alternative as well as the estimated costs for the recommended improvements to support the Master Plan Update.

5.1 Alternative Technology Selection

Both conveyance and storage technologies' performance and feasibility were compared for inclusion in the recommended alternative. This section provides a summary of both collection systems technologies.

5.1.1 Conveyance

Conveyance technologies are typically considered for eliminating localized hydraulic bottlenecks and maximizing the quantity of flows conveyed to downstream treatment plants or in some cases storage facilities. Technologies to remove the existing bottlenecks or increase the existing conveyance capacity typically include:

- Constructing new relief interceptors
- Replacing/upsizing existing sewers
- Constructing new wet weather lift stations and forcemains

Depending on local hydraulic conditions, soils and land availability, various construction techniques could be considered including for new and upsized sewers including:

- Open cut pipe
- Short bore tunnels (trenchless)
- Pipe bursting (upsizing existing smaller diameter pipes)

Conveyance solutions for this master plan update typically involved increasing the size of all necessary conduits in order to pass the peak flows for the 10-year 12-hour storm to the Laguna Treatment Plant (LTP) without violating the City's level of service (LOS) goals. A conveyance-only solution can meet the LOS, however, it often requires a significant portion of the sanitary network to be upsized potentially resulting in significant costs.

Another important factor in a conveyance-only solution is the staging of the improvements. In most cases, improvements are installed from downstream to upstream in order to prevent flows in upstream areas that were restricted due to undersized conduits being released and impacting downstream portions of the system. Some considerations that may impact the cost, schedule, and planning of conveyance solutions include:

- Depth, diameter, and length of conduit requiring upsizing
- Overall cost of upgrades (material, equipment, labor, contingencies)
- Location of conduits (i.e. buried under roads, sidewalks, or grass)
- Temporary re-routing of flows during construction
- Traffic control during construction

5.1.2 Storage

A storage solution requires the construction of one or more storage tanks generally with complimentary conveyance upgrades at locations that will have significant impact on the LOS. The greatest LOS relief is typically found within the immediate vicinity of the storage tank and can continue for downstream portions of the system. The amount of LOS relief is dependent on the tank location, size, and local hydraulics of the collection system. In a combined storage/ conveyance solution, the relief provided by the storage tanks means that a smaller portion of the sanitary network will have to be upsized to meet the LOS.

The primary advantage of storage tanks is the potential for significant attenuation of wet weather flows. The primary disadvantage is its high capital cost. Additional disadvantages include increased O&M costs for pumping, odor issues, visual aesthetics, the need to clean up after each event, the need for adequate construction sites and the potential for disruption of adjoining sites or neighbors during construction and operation.

Some considerations that may impact the cost, schedule, and planning of storage solutions include:

- Location of storage tank(s), and current property ownership
- Overall costs (material, equipment, labor, contingencies (for both storage tank construction and conveyance upsizing))
- Size of storage tank
- Above ground or below ground storage
- Odor control
- Public perception of storing sanitary flow
- Operating Controls
- How sanitary flow enters and exits the storage facility (gravity fed vs. pumped)

- Facility security
- Operation and Maintenance (O&M) costs

5.2 Recommended Alternative

While several potential locations for off-line storage were initially screened, discussions with the City resulted in the elimination of storage as an option for managing flows at this time. Storage alternatives were not evaluated further because:

- Procurement of additional property, as well as associated easement acquisition and potential mitigation of sites, by the City likely will be cost-prohibitive.
- City staff did not, at this time, want to incur additional operating and maintenance costs associated with off-line storage facilities.

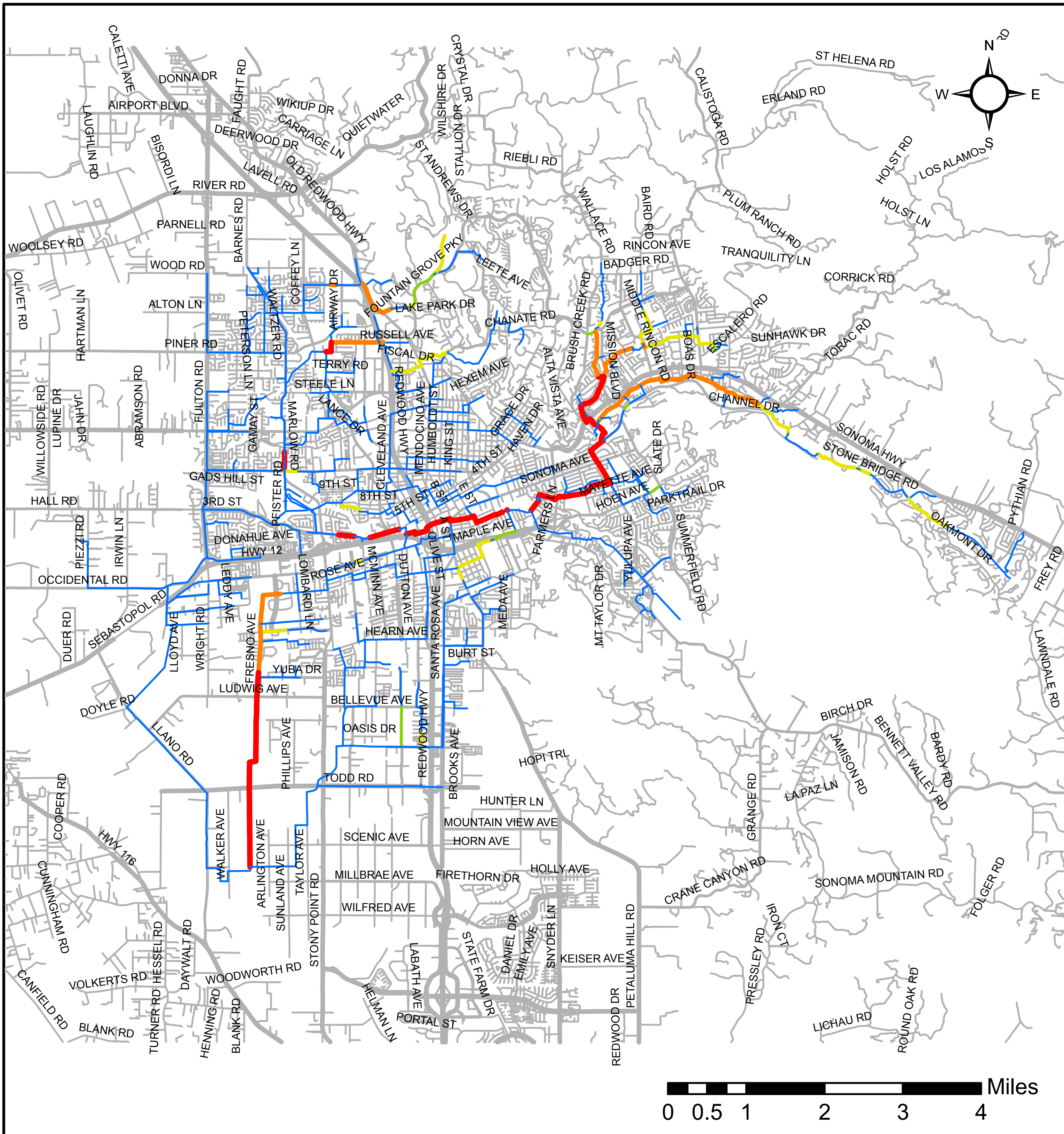
However, the City reserves the right to evaluate storage facilities in the future where practical and cost effective.

5.2.1 Conveyance Upgrades

To meet the minimum LOS for the 10 year 12 hour design storm, approximately 18% (24 miles) of the modeled network requires upsizing. Figure 5-1 shows the location and size of the replaced pipes. Table 5-1 displays the total modeled length of conduit, by diameter, for the existing and future upsized conditions. As can be seen, Figure 5-1 shows the majority of upsizing is required along the Cross Town Trunk Sewer and the Los Alamos Trunk Sewer. Note that Figure 5-1 shows the required upsizing does not continue downstream of the WCSF. This is a result of the new controls and the planned second connection from the 1400 meter basin governing the operation of the facility, along with the anticipated increased capacity at the Laguna Treatment Plant.

Table 5-1: Summary of Conveyance Upgrades by Length and Diameter

Diameter (in)	Existing Conduit (ft)	Upsized Conduit (ft)
6	13,356	12,374
8	16,457	12,078
10	134,336	130,316
12	164,403	151,957
14	3,480	2,660
15	85,644	77,644
16	16,732	12,236
18	29,785	47,979
20	7,022	8,314
21	22,756	15,354
24	42,226	59,667
27	18,803	11,107
30	30,466	35,770
33	21,608	6,769
36	21,458	21,871
39	11,825	5,372
42	7,400	25,930
45	6,344	16,703
48	7,431	7,431
54	13,083	13,083
60	9,461	9,461
66	22,529	22,529
Total Length		706,606 (134 miles)



Conduit Change

- No Change
- 8" - 12"
- 15" - 20"
- 24" - 30"
- 36" - 45"

CITY OF SANTA ROSA
CALIFORNIA

MASTER PLAN UPDATE

RECOMMENDED CONVEYANCE UPGRADES

ARCADIS

City of Santa Rosa California

FIGURE
5-1

5.2.2 Storage Evaluation

Storage requirements at the WCSF were evaluated assuming the recommended alternative was fully implemented. Table 5-2 shows the predicted storage in the emergency pond (Pond 1) for the 10 and 25 year events. As shown, even with the full implementation of the recommended system upgrades, the storage required is less than what is being reserved for sanitary flow in the emergency overflow pond.

Table 5-2: Emergency Storage (Pond 1) Utilization after Upgrades

Event	Storage Required (MG)
10 yr. 12 hr.	6.5
25 yr. 12 hr.	20
Available Storage 22.6 MG	

Additional analysis was performed to characterize the peak flow and total volume conveyed from the CTTS and OTTS to the WCSF to provide the City with an assessment of storage requirements during extreme conditions. This analysis was conducted with two system configurations: current sanitary flows in the existing system and future sanitary flows in a system where all recommended upgrades were implemented. Each configuration was run for the 1, 2, 5, 10, 25, 50, and 100 year storms. These scenarios assumed all bottlenecks downstream of the WCSF are eliminated. Table 5-3 presents the results for existing conditions while Table 5-4 summarizes the results for future conditions.

Table 5-3: Peak Flow and Total Volume Delivered to WCSF for Existing Conditions

Current Sanitary Flow/ Existing System					
Event	Peak Flow (MGD)		Volume (MG)		
	OTTS	CTTS	OTTS	CTTS	Total Volume
1 Year	20.9	10.2	39.0	21.9	60.9
2 Year	22.5	10.9	40.9	22.4	63.3
5 Year	25.6	13.7	47.5	24.5	72.0
10 Year	27.6	16.2	52.2	26.1	78.3
25 Year	28.8	19.1	57.7	28.6	86.2
50 Year	29.4	19.8	59.5	29.4	88.9
100 Year	30.1	21.1	62.1	30.7	92.9

Table 5-4: Maximum Flows By WCSF for Future Conditions

Future Sanitary Flow/ Recommended Upgrades Implemented					
Event	Peak Flow (MGD)		Volume (MG)		
	OTTS	CTTS	OTTS	CTTS	Total Volume
1 Year	23.9	10.9	41.1	24.3	65.4
2 Year	26.3	11.6	43.1	24.9	68.0
5 Year	35.4	14.5	50.7	26.9	77.5
10 Year	41.5	16.8	57.2	28.5	85.7
25 Year	45.8	19.5	65.7	31.0	96.7
50 Year	46.1	20.5	68.5	31.8	100.3
100 Year	46.6	22.2	72.5	33.2	105.7

Table 5-5 displays the actual length of upsized conduit. The total length of upsized conduit recommended as part of this alternative is 122,770 feet, or 23.3 miles. This represents 18% of the modeled system, and 4% of the entire length of the City's wastewater collection system.

Table 5-5: Length of Conduit Upsized

Diameter (in)	Length (ft)
8	400
10	5,130
12	7,589
15	17,272
18	18,453
24	23,059
30	9,903
36	13,593
42	18,540
45	10,359
Total	122,770 (23.3 mi)

5.3 Alternative Costs

This section discusses the development of unit costs and the total estimated cost of construction, including contingency costs, for the recommended alternative.

5.3.1 Unit Cost Development

Unit costs were developed using information gathered from ARCADIS local engineering costs from projects constructed under similar conditions (2007 – 2012), and internal 2013 Construction Guidelines, developed based on company experiences.

The pipe unit costs include materials and industry standard installation work including trenching, bedding, pipe installation, compaction, backfilling, pavement replacement, and manhole replacement. These costs do not include purchase of land, easements and mitigation of potential wetland impacts. Table 5-6 displays the unit costs for new conduit that were used to develop alternative costs.

Table 5-6: Unit Costs

Depth	Conduit Size										
	8"	10"	12"	15"	18"	20"	24"	30"	36"	42"	45"
0'-6'	$136	$151	$182	$209	$238	$266	$266	$311	$390	$514	$514
6'-8'	$136	$151	$182	$209	$238	$266	$266	$311	$390	$514	$514
8'-10'	$146	$161	$192	$219	$248	$278	$278	$323	$404	$530	$530
10'-12'	$156	$171	$202	$229	$258	$290	$290	$335	$418	$546	$546
12'-14'	$166	$181	$212	$239	$268	$302	$302	$347	$432	$562	$562
14'-16'	$176	$191	$222	$249	$278	$314	$314	$359	$446	$578	$578
16'-18'	$186	$201	$232	$259	$288	$326	$326	$371	$460	$594	$594
18'-20'	$196	$211	$242	$269	$298	$338	$338	$383	$474	$610	$610
20'-22'	$206	$221	$252	$279	$308	$350	$350	$395	$488	$626	$626
22'-24'	$216	$231	$262	$289	$318	$362	$362	$407	$502	$642	$642
24'-26'	$226	$241	$272	$299	$328	$374	$374	$419	$516	$658	$658
26'-28'	$236	$251	$282	$309	$338	$386	$386	$431	$530	$674	$674
28'-30'	$246	$261	$292	$319	$348	$398	$398	$443	$544	$690	$690
30'-32'	$256	$271	$302	$329	$358	$410	$410	$455	$558	$706	$706
32'-34'	$266	$281	$312	$339	$368	$422	$422	$467	$572	$722	$722

5.3.2 Total Cost of System Upgrades

Table 5-7 presents the order of magnitude costs for the recommended gravity system improvements shown on Figure 5-1. The costs presented here are order of magnitude planning level costs in Year 2013 dollars. The expected accuracy range is from minus 30 percent to plus 50 percent. Based on this expected accuracy range, a design contingency of 15 percent is included in the Conceptual Costs. This contingency appropriately takes into consideration the level of engineering and design documentation available at the time this cost is prepared, uncertainty related to the competitive conditions of the local construction market at the time of bid sometime in the future, uncertainty related to future increases in raw material costs, and uncertainty related to bidders' assessments of project risks. In addition, we have added an additional 25 percent to account for non-construction engineering related costs associated with these projects.

Based on these assumptions, the conceptual costs of the Recommended Alternative are estimated to be $64.4 million.

Table 5-7: Order of Magnitude Costs

Estimated Alternative Cost	$44.8 M
15% Design Contingency	$6.7 M
25% Engineering Contingency	$12.9 M
Total Recommended Alternative Cost	$64.4 M

The improvements and associated costs presented in this section represent conceptual solutions to address projected growth through 2035. While growth projections have been based on the best available information, the need for the proposed improvements will ultimately be triggered by actual future flow conditions in the system. Ultimately, the timing and size of the final improvements will be controlled by the distribution of development activity and associated flow increases. Therefore, the City should continue its ongoing flow monitoring and modeling program, and develop a program to use that information to track actual growth rates. This real flow information will help determine when new facilities are needed, and support the necessary refinement of sizes and costs during the design process.