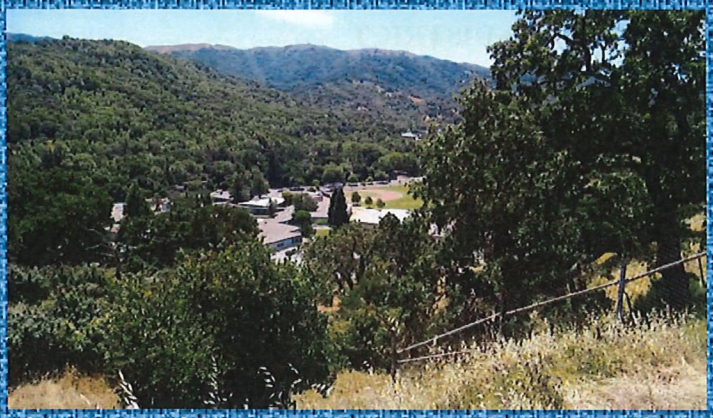

FEASIBILITY STUDY OF WEST IGNACIO RECYCLED WATER EXTENSION

NMWD JOB NO. 5.2806.00

North Marin Water District

September 2017

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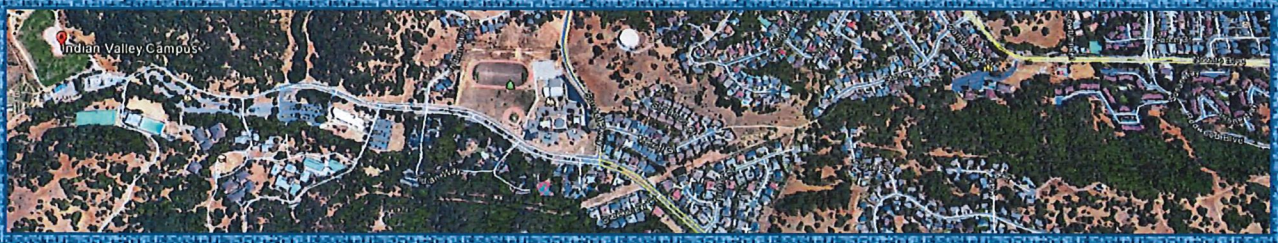


NORTH MARIN WATER DISTRICT

FEASIBILITY STUDY OF A WEST IGNACIO RECYCLED WATER EXTENSION

TABLE OF CONTENTS

NORTH MARIN WATER DISTRICT

FEASIBILITY STUDY OF WEST IGNACIO RECYCLED WATER EXTENSION

NMWD Job No. 5.2806.00
Draft July 6, 2017

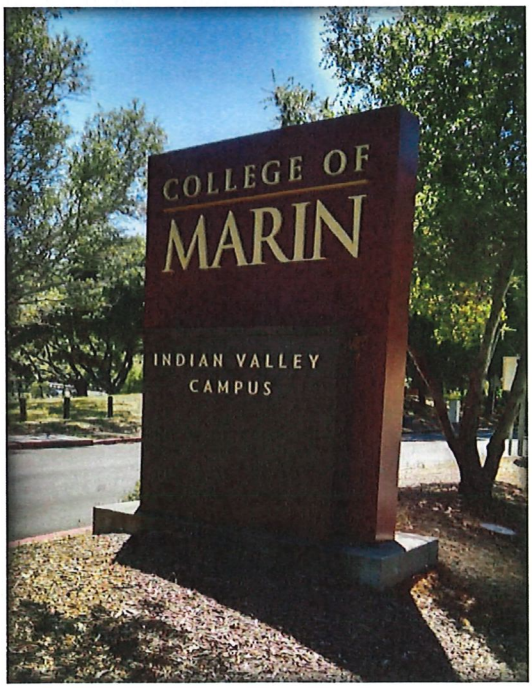
INTRODUCTION

The North Marin Water District (NMWD) has extended its recycled water distribution system from Novato Sanitary District's Davidson St treatment facility into Central Novato and the Ignacio area of Southern Novato. In Ignacio the recycled water pipeline extension runs along Ignacio Blvd and terminates at Country Club Drive and will serve the Marin Country Club golf course.

The West Ignacio Recycled Water Extension would involve constructing a pipeline west along Ignacio Blvd to serve the Novato Unified School District's (NUSD) San Jose Middle School campus and the College of Marin Indian Valley Campus (IVC) as shown in Figure 1. Meters will also be installed along the pipeline route to serve other irrigation uses, which include streetscape irrigation, parks and HOA's landscape irrigation areas also shown in Figure 1.

This study was initiated at the request of the Novato Unified School District and the College of Marin to evaluate the feasibility of extending recycled water to both campuses. Funding for the study is shared equally (50/50) between both parties.

The College of Marin is in the process of developing a Master Plan for upgrading the IVC. It is appropriate to consider use of recycled water for landscape irrigation and toilet flushing in new buildings. At the west end of the IVC, recycled water could be used for the organic farm and garden and the City of Novato athletic fields.



The IVC has become a vital educational and community resource with over 17 different career technical education programs. The Indian Valley Organic Farm and Garden is a rich collaborative program with the Conservation Corps North Bay, the UC Cooperative Extension and the Cultural Conservancy. In addition, each year thousands of swimmers from all over Marin County and beyond take advantage of the Olympic-sized pool at IVC.

The existing NMWD recycled water pipeline now terminates at Ignacio Blvd and Country Club Drive

and will serve the Marin Country Club golf course. The planned water pressure at the Country Club Drive will be 25 psi, which means that a booster pump will be required to supply recycled water to customers to the west. Included in this feasibility study are the estimated costs of extending a recycled water line on Ignacio Blvd, together with the necessary pumping and necessary storage to insure the proper availability and pressure.

ACKNOWLEDGEMENTS

For their helpful cooperation in preparing this feasibility study we would like to acknowledge Drew McIntyre, Manager of the NMWD, Rocky Vogler, Chief Engineer, Robert Clark, Operations/Maintenance, and Ryan Grisso, Water Conservation Coordinator. In addition, we would like to acknowledge College of Marin's Greg Nelson, Vice President of Finance and College Operations and Billy Pate, maintenance and operations as well as Michael Millet of LPAS Architecture + Design and Yancey Hawkins of the Novato Unified School District.

STUDY OBJECTIVE

The objective of the West Ignacio feasibility study is to identify the estimated recycled water demands, the pipeline route, pump station location, and any necessary storage together with estimates of the construction costs to provide recycled water to the NUSD San Jose Middle School, the College of Marin IVC and other nearby irrigation users.

BACKGROUND

The 2004 NMWD Recycled Water Master Plan (Reference 2) analyzed the feasibility of constructing a recycling water system to serve irrigation customers in the Novato area. The Master Plan identified service areas, existing and potential future irrigation customers, together with pipeline routes which would maximize the number of irrigation customers which could be served.

The initial recycled water project implemented in NMWD involved serving the Stonetree Golf Course at Black Point from a temporary treatment facility at the Novato Sanitary District (NSD) reclamation site.

In 2006, an Implementation Plan (Reference 3) updated the Master Plan and recommended relocation of the recycled water treatment facility to the NSD treatment plant located at the end of Davidson Street. The Implementation Plan also determined that it would be more cost effective to provide recycled water to the Hamilton service area in Southern Novato from the Las Gallinas Valley Sanitary District (LGVSD) treatment plant in northern San Rafael.

Based on the Implementation Plan distribution pipelines were constructed to serve areas in North Novato from the NSD Davidson St treatment facility and in the Hamilton residential area of south Novato from the LGVSD treatment facility.

NMWD has now extended the recycled water distribution pipeline from the North service area into Central Novato on the west side of Highway 101 and into the Ignacio area. This project includes installation of a recycled water pipeline in Ignacio Blvd terminating at Country Club Drive.

By extending this pipeline further west along Ignacio Blvd recycled water service could be provided to the San Jose Middle School athletic field, College of Marin IVC and the City of Novato athletic field. Because of the higher elevation a second pressure zone will need to be established.

RECYCLED WATER QUALITY

The tertiary recycled water produced at the NSD recycled water facility for irrigation complies with State Water Resources Control Board General Order WQ 2014-0090 DWQ, which incorporates disinfection requirements conforming to the California Department of Health Services Title 22 criteria for unrestricted use and is approved for irrigation of all food crops including direct contact with the edible portion of the crop.

In accordance with the NMWD enrollment under the State's General Order and the NMWD Standard Recycled Water Specifications the following restrictions apply regarding the use of recycled water (RW).

- Tertiary RW is approved for Minimum 48" horizontal and 12" vertical separation required between onsite RW and potable lines
- Sites with both RW and potable lines require backflow protection on the potable lines, immediately downstream of the potable meter(s)
- RW can't be used as drinking supply for animals

RECYCLED WATER USE AS IRRIGATION WATER

The recycled water quality is based in part on the initial quality of the potable water plus the loading that occurs during the conversion to wastewater and finally, the wastewater treatment process itself. Certain mineral constituents such as dissolved solids, which in high enough concentrations can be detrimental to plants, are not removed in the wastewater treatment or recycled water treatment processes.

Fortunately, the quality of the potable water supply in the Novato is good and has low concentrations of dissolved solids. Table 1 summarizes the water quality of the recycled water as tested by NMWD. This water quality is considered to have only slight irrigation restrictions. See Appendix A for a more detailed discussion of Water Quality Guidelines for Irrigation Use, which is an updated excerpt from Reference 1 which includes an updated table comparing the water quality guidelines for irrigation use to the average NMWD recycled water quality from the NSD treatment facility.

TABLE 1 – NORTH MARIN WATER DISTRICT
RECYCLED WATER CHEMISTRY - NORTH AND CENTRAL SERVICE AREAS
FROM THE NOVATO SANITARY DISTRICT
RECYCLED WATER TREATMENT FACILITY

Chemical parameter	Unit of measure	Range minimum	Range maximum	Average
Calcium	mg/L	23.4	33.7	30
Chloride	mg/L	106	149	125
Conductivity	µS/cm	726	1017	875
Hardness	mg/L	138.2	172	153
Magnesium	mg/L	17	18.4	17.6
Nitrate (as N)	mg/L	11.1	16.9	14.7
Ortho-phosphate (as P)	mg/L	0.066	2.47	1
Potassium	mg/L	16.2	16.2	16.2
Sodium	mg/L	59.2	138	103.4
Sulfate	mg/L	40	54.6	43.6
Total Dissolved Solids	mg/L	461	540	506
pH	Units	7.08	7.61	7.36

INVENTORY OF POTENTIAL RECYCLED WATER USERS IN SERVICE AREA S-4

The service area west of the Marin Country Club is designated as Service Area S-4 in the 2004 Recycled Water Master Plan. The irrigation water users in this service area consist of existing and future landscaped areas, two athletic fields and the IVC vegetable garden together with the City's Hoog Park and medians in Ignacio Blvd. There is one homeowners association that has a separate irrigation meter.

Synthetic turf - A number of athletic fields have been converted to synthetic turf. Most of these fields use synthetic rubber crumbs in green plastic lawn. The impetus in converting to synthetic turf is the reduced maintenance and lower irrigation water use. Athletic turf can be used year-round because it drains better after rains and does not get torn up as much as natural turf. An irrigation system may be installed in synthetic turf to provide temperature control, pathogen/bacteria control, etc.

Per Reference 5 natural turf costs about $15/square foot (sf) and synthetic turf costs $20/sf. Two potential recycled water users in this service area, the NUSD San Jose Middle School and the City of Novato athletic field may be converted to synthetic turf in the future as discussed below.

College of Marin IVC - The College of Marin is in the process of developing a Master Plan for the Indian Valley Campus. On a preliminary basis it is estimated that once fully implemented the area to be landscaped will consist of 14.95 acres. Landscaping will include sod, shrubs and trees,

all of which could be irrigated with recycled water. Sod will require the most water. Shrubs and trees will most likely be irrigated by a drip system and as they mature the irrigation requirement will drop off and eventually some trees and shrubs will not need to be irrigated at all.

The applied water requirement for sod irrigation is based on irrigation of cool season grasses in the Novato area (Reference 3) is shown below.

Evapotranspiration for cool season grasses, ETg	30.8"/year (April to October)
Irrigation efficiency, E	0.75
Applied water requirement, AWR (ETg/E – Rain)	26.5"/year
(Rain = Avg rainfall at Stafford Lake of 27"/year)	

Since the master plan for the IVC is still under development, for the purpose of this study a future high and low irrigation demand at IVC has been calculated. The high demand would consist of the full irrigation requirement of sod (factor = 1.0) and the low demand would be less than half the sod requirement (factor = 0.45) as shown below.

High demand: 14.95 ac x 26.5"/yr/12 x 1.0	33.0 ac. ft.
Low demand: 14.95 ac x 26.5"/yr/12 x 0.45	14.9 ac. ft.

These high and low values have been included in Table 2 below for site 1, which is the College of Marin IVC irrigation meter at 1800 Ignacio Blvd.

NUSD San Jose Middle School

The NUSD San Jose Middle School is located at the intersection of Ignacio Blvd and Sunset Parkway. The school has almost 6 acres of irrigated athletic fields. The NUSD board is considering budgeting for installation of synthetic turf at the San Jose Middle School. Considering the uncertainty of the timing and installation possibilities of synthetic turf in the athletic field, the recycled water use projections at the San Jose Middle School will be based on a high water use (turf irrigation) and low water use (with synthetic turf). There are no plans to replace the turf in the baseball field.

For the purpose of estimating the low water use requirement it is assumed that the San Jose Middle school will install 100,000 sq. ft. (2.30 acre) of synthetic turf. The reduction of irrigation water demand is computed below for this one soccer field with synthetic turf:

Deduct: 2.30 ac x 26.5"/yr/12 = 5.08 ac. ft.

The high demand given in Table 2 below is the average measured irrigation water demand as measured by NMWD through the existing irrigation meter. The low demand assumes installation of synthetic turf with a 5.08 acre foot reduction in the existing irrigation demand.

IVC Garden – As discussed above and shown in Table 1 the quality of the recycled water to be provided is very good and would pose no restrictions for irrigation of vegetables including contact with the edible portion of vegetables. Conversion of the IVC garden to recycled irrigation water is encouraged.

City of Novato Athletic Field – The City of Novato athletic field is located at the westerly end of Ignacio Blvd and consists of approximately 4.5 acres of irrigated turf, which does not include two unirrigated baseball diamonds. Reference 5 estimates that synthetic turf could be installed on 5.6 acres which would include placing the synthetic turf in the baseball diamonds at a cost of $4.9 million. An expenditure of this amount of money may depend on grants. It is possible that because of the costs the synthetic turf will only be installed in the marked out playfield boundaries and the surrounding area will remain as irrigated turf. Reference 5 contains a map showing an outline of two soccer fields where synthetic turf could be installed, a smaller field of 1.0 acres and a larger field of 1.5 acres for a total of 2.5 acres. The remainder of the athletic field would be irrigated turf. The reduction in irrigation water demand assuming 2.5 acres of synthetic turf is shown below.

Deduct: 2.5 ac x 26.5"/yr/12 = 5.52 ac. ft.

Considering the uncertainty of installing synthetic turf in the athletic field, the recycled water use projections in Table 2 below will be based on a high (historic irrigation water use) and low (with synthetic turf).

Toilet Flushing – Inside public buildings recycled water can be used for toilet flushing. This requires separate piping to bring the recycled water to the toilets and is most feasible in new public buildings or where there is a major remodel. Use of recycled water for toilet flushing has the benefit of reducing the overall usage of potable water and should be encouraged. For the purpose of this study toilet flushing with recycled water has not been included in the projected usage.

Projected Recycled Water Use in Service Area S-4 – The current irrigation water users are shown on Figure 1 and an inventory of their current water use is given in Table 2. In most cases the water usage figures shown in Table 2 are averaged over 10 or 12 years, which saw a lower

usage for some meters during the last four drought years. Projections have been made for new irrigated areas in the IVC campus.

In summary, the projected recycled water demand for Service Area S-4 when fully connected will be between 51 and 80 acre feet per year requiring between 111,000 and 174,000 gallons per average day during the peak month, which is usually June or July. The recycled water requirement during the peak days is projected to be between 189,000 and 295,000 gallons per day. Peak hour flows will be between 387 and 603 gallons per minute.

TABLE 2 – NMWD WEST IGNACIO RECYCLED WATER FEASIBILITY STUDY SERVICE AREA S-4

	Location	Annual AF/yr[1]	Peak Month[2] gal/mo	Avg Day Peak Month[3] gpd	Peak Day[4] gpd	Peak Hour[5] gpm
1	College of Marin IVC Irrigation Meter 1800 Ignacio					
	High value	33.00	2,150,617	71,687	121,868	249
	Low value	14.90	971,036	32,368	55,025	112
2	College of Marin IVC Garden 1800 Ignacio	3.23	210,499	7,017	11,928	24
3	San Jose Middle School NUSD					
	High value	11.74	765,365	25,512	43,371	89
	Low value	6.66	434,034	14,468	24,595	50
4	Hoog Park, 571 Marin Oaks Dr. - City of Novato	9.66	629,206	20,974	35,655	73
5	San Jose Middle School, 1000 Sunset Pkwy – NUSD	2.80	182,443	6,081	10,338	21
6	City of Novato Athletic Field 1800 Ignacio Blvd					
	High value	13.00	847,322	28,244	48,015	98
	Low value	7.48	487,473	16,249	27,623	56
7	Ignacio Creek HOA, 298 Indian Way	3.18	207,334	6,911	11,749	24
9	City Median 1501 Ignacio Blvd	1.45	94,710	3,157	5,367	11
10	City Median 1503 Ignacio Blvd	1.26	81,899	2,730	4,641	9
11	City Median 1718 Ignacio Blvd	0.62	40,634	1,354	2,303	5
	TOTAL - HIGH	79.94	5,209,706	173,657	295,217	603
	TOTAL - LOW	51.24	3,339,321	111,311	189,228	386

[1] AF = Acre foot = 325,851 gallons
[2] Peak Month = 20% of annual flow
[3] Average day peak month assumes 30 day month
[4] Peak Day = 1.7 x average day for peak month
[5] Peak Hourly Flow = 5 x average day peak month

Abbreviations:
AF/yr - Acre feet per year
gpd - gallons per day
gpm - gallons per minute
Source: Reference 1

SEQUENCING OF RECYCLED WATER DELIVERIES IN WEST IGNACIO

The West Ignacio irrigation customers in Service Area S-4, which include the San Jose Middle School and the College of Marin IVC, will generally irrigate during non-activity hours. Some

drip irrigation may occur anytime of the day depending on the controller programming.

Recycled water provided to customers in Service Area S-4 must pass though Service Area S-3. The Marin Country Club (MCC) Golf Course is the major user in S-3 and will irrigate during the night. The NMWD agreement with MCC for recycled water delivery provides as follows:

> "WHEREAS, the delivery of up to 336,000 gallons of recycled water per day will be taken by Applicant over a minimum seven (7) hour period resulting in a maximum instantaneous rate of flow up to 800 gallons per minute (gpm);"

In addition to the MCC recycled water demand, there are additional demands in the S-3 area plus demands in S-4 if it is connected. The Norman tank which has been incorporated into the Service Area S-3 system has a storage capacity of 500,000 gallons.

To avoid overloading the distribution and storage system serving Service Area S-3 during the peak irrigation times it will be important to provide additional recycled water storage in Service Area S-4. This storage tank should be large enough to be filled during the daytime so irrigation can occur at night. Considering the high demand of the Marin Country Club golf course it would be preferable to fill the new storage tank over a 16 hour period. Filling over a 24 hour period would also be feasible but could strain the ability of the Norman tank and Davidson St treatment facility to provide recycled water at night when the downstream irrigation demands are high.

Because of its higher elevation booster pumps will be required to establish a second recycled water pressure zone in Service Area S-4. The booster pump station should be located near Country Club Drive at the termination of the existing pipeline.

BASIS OF DESIGN

Service Area S-4 is at the end of the distribution system serving Central Novato. If the demands in Central Novato are too great or the delivery of recycled water is not timed correctly there may not be enough capacity to fulfill the recycled water demands in the S-4 area.

The best strategy to achieve this will be to use the booster pump to fill a storage tank during the daytime hours when the irrigation demands are low so that customers in the second pressure zone can irrigate at night without exerting an excessive demand on the downstream system. Table 3 lists alternative design criteria for the high recycled water demands in Service Area S-4 (80 AF/yr – see Table 2).

Pipeline Sizing – The distribution pipeline within Service Area S-4 should be sized to convey the peak hour flow of 603 gpm at a reasonably low velocity (less than 7 fps). The pipelines in

TABLE 3 – ALTERNATIVE PUMPING DESIGN CRITERIA FOR SERVICE AREA S-4

	Avg Day Peak Month, gpd		Peak Day, gpd	
	High	Low	High	Low
Required RW Volume, gallons				
	173,657	111,311	295,217	189,228
16 Hour Tank Fill				
Pumping rate, gpm	181	116	308	197
24 Hour Tank Fill				
Pumping rate, gpm	121	77	205	131

this service area are at the end of the recycled water system since the area is mostly surrounded by hills. However, there is the possibility that in the future a pipeline could be constructed in the Indian Valley fire road in order to loop the RW distribution system to Indian Valley Road in the western service area of Novato.

NMWD has been standardizing its RW pipeline sizes to 8, 12 and 16 inch diameters. This standardization allows NMWD to minimize its stock sizes of such items as service saddles and repair clamps.

For a peak flow of 603 gpm the velocity in an 8" diameter pipe will be around 4 feet per second which is well below the maximum of 7 feet per second. A 12" diameter pipe would have a velocity of less than 2 feet per second at this peak flow. For the purpose of this feasibility study the recycled water pipelines serving Service Area S-4 are assumed to be 8" diameter.

Storage Tank – Ideally the storage tank for Service Area S-4, which will be in its own pressure zone, should be sized to hold all the water needed for the night's irrigation demand. If it holds less volume than the night's demand then more water will need to be pumped from Service Area S-3 during the nighttime hours when the Marin Country Club golf course and other Central service area customers are irrigating. If the storage tank in the S-4 area is larger than needed then it could serve as a backup to the Central service area.

The projected flows into Service Area S-4, for the high and low recycled water demand are listed below:

Recycled water usage	High Projection	Low Projection
Average day peak month, gallons	173,657	111,311
Peak Day, gallons	295,217	189,228

For the purpose of this feasibility study a 150,000 gallon tank will be preferable since it is about midway between the high and low projections for the average day peak month. A smaller tank will require more pumping from Central Novato during nighttime hours.

Booster Pump Station – A booster pump station will be required in order to develop a second pressure zone to serve Service Area S-4. Assuming that a storage tank is provided then the capacity of the pump station should be established to fill the tank during the daytime hours. If filling is done over 16 hours the pump station should have a capacity of 180 gpm. For reliability duplicate pumps should be provided. During a peak day an additional 120,000 gallons may be required, which, assuming the storage tank is full, will require additional pumping of about 250 gpm when customers are irrigating.

At Ignacio Blvd and Country Club Drive the elevation of the booster pump station will be approximately 75 feet. The elevation of the City athletic field at the end of Ignacio Blvd is around 220 feet. If a storage tank has a minimum water surface elevation of 340 feet it will provide 52 psi at the athletic field (assuming no friction losses).

Summary – Based on the above analysis the following are the recommended design criteria for recycled water facilities in Service Area S-4:

Minimum distribution pipeline diameter – 8"
Booster pump station capacity – 250 gpm @ 120 psi
Storage tank volume – 150,000 gallons (preferred)

BASIS FOR ESTIMATING COSTS

For the purpose of this feasibility study estimates of the project costs are based on projected 2017 costs using the following assumptions:

- Pipeline costs based on the recent construction costs of recycled water pipelines installed in NMWD's Central Service Area Recycled Water Expansion Project. The estimated construction costs for 8" diameter PVC pipes = $220/LF.
- Tank upgrade costs are assumed to be as stated.
- Pumping station costs are assumed to be as stated.
- Construction contingency = 20% of construction cost.
- Planning, design and construction management = 25% of total construction cost including contingencies.

The range of accuracy of the cost estimates is considered to meet the Class 4 level per AACE 56R-08 Cost Estimate Classification System which has an expected accuracy range of a low of -10% to -20% and a high of +20% to +30%.

The estimated project costs should be escalated 5% per year to the construction year.

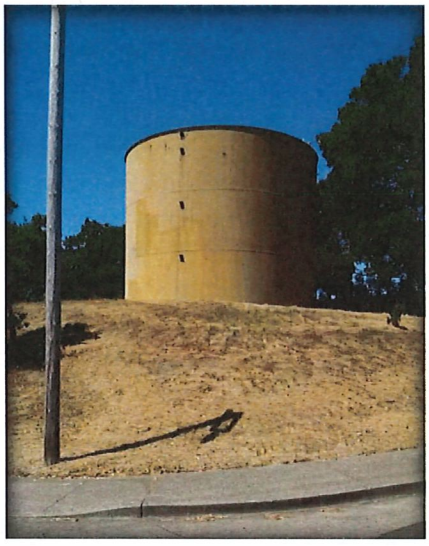
STORAGE TANK FOR SERVICE AREA S-4

For Service Area S-4 in west Ignacio to serve the San Jose Middle School and the IVC it will be necessary to establish a pressure zone because of the higher elevation of the area. Recycled

water will need to come from the end of the pipeline now under construction, which will terminate at the Ignacio Blvd and Country Club Drive, which is the service point for the Marin Country Club golf course. A booster pump and storage tank will be needed to provide recycled water to the Service Area S-4 customers.

Irrigation of the golf course and of most if not all of the irrigation customers in the Service Area S-4 zone will occur at night. To void overtaxing the Norman tank or the distribution pipelines in the lower pressure zone serving Central Novato it will be necessary to provide a storage tank for the Service Area S-4 system. Ideally, the storage tank should have capacity for the average day peak month of the service area, which is between an estimated low of 113,000 and an estimated high of 174,000 gallons per day. A 150,000 gallon storage tank would be around half way between these two estimates. If the low recycled water projections are realized a smaller tank would be sufficient.

Two alternative tank sites in the Service Area S-4 system are discussed below.



Woodland Heights Tank – The existing decommissioned NMWD Woodland Heights tank is located on Oak View Court east of the Sunset Parkway. It has a capacity of 120,000 gallons with a bottom elevation of 328 and an overflow elevation of 351. Although this tank is relatively small it has good elevation and could provide good pressure to Service Area S-4. The Woodland Heights tank is relatively close to the Sunset Parkway and could be connected by a water line constructed up the hill via easements. The tank needs painting and other repairs are estimated to cost $400,000. A 2,000 foot long pipeline connection from Ignacio Blvd will be needed at an estimated cost of $440,000.

New Storage Tank on College of Marin Property – The IVC campus has hills on the north and south sides, which could provide the necessary elevation for a new storage tank. One possible location is next to the PG&E access road to their power line on the south side of the campus as shown in Figure 1. This tank site is located on a dirt PG&E access road and has an elevation of around 340 feet. The road is steep and rutted and would need to be improved to allow all weather vehicle access. The distance from the end of Ignacio Blvd to the tank site is about 3,100 feet at an estimated cost of $682,000. A new 150,000 gallon bolted welded steel tank is estimated to cost about $300,000, exclusive of the foundation, site work and access road improvements. It should be possible to route the pipeline through the IVC campus in an

alignment that would provide recycled water to irrigated landscape areas to reduce the cost of in-tract distribution pipelines.

ALTERNATIVE RECYCLED WATER PROJECTS

Extension of the NMWD recycled water distribution line to serve West Ignacio customers including the San Jose Middle School and the Indian Valley Campus will logically follow Ignacio Blvd. Alternative projects involve the location of the necessary storage tank and are shown in Figure 1 and described below.

Alternative A – Construct a new 8" diameter recycled water line in Ignacio Blvd from Country Club Drive to the City athletic field at the west side of the IVC and rehabilitate the existing Woodland Heights storage tank. This tank only has a capacity of 120,000 gallons which is less than the estimated average daily demand during the peak month. The connecting line from Ignacio Blvd to the Woodland Heights tank would follow Sunset Parkway and then run uphill in easements and on Oak View Court to the tank. The estimated cost of Alternative A is given below.

8,500 LF 8" dia. pipeline in Ignacio Blvd	@$220/LF	1,870,000
2,000 LF 8" dia. pipeline from Ignacio Blvd to Woodland Heights tank (120,000 gallons)	@$220/LF	440,000
Est. Woodlands Heights storage tank upgrade		400,000
Est. Booster pump station		140,000
Subtotal		2,850,000
Construction contingency (20%)		570.000
Subtotal		3,420,000
Planning, design, CM (25%)		855,000
OPINION OF PROBABLE PROJECT COST		$4,275,000

Alternative B – Construct the recycled water line in Ignacio Blvd from Country Club Drive to the City athletic field. and construct a new storage tank on College of Marin property. The proposed new tank will have a capacity of 150,000 gallons. A possible site for a new tank with good elevation is on the hill south of the campus close to the PG&E power lines and next to a dirt access road. The connecting line to the new tank would run through the IVC campus and could be used to serve adjacent irrigated areas. The estimated cost of Alternative B is given below.

8,500 LF 8" dia. pipeline in Ignacio Blvd	@$220/LF	1,870,000
3,100 LF 8" dia. pipeline from Ignacio Blvd to new storage tank	@$220/LF	682,000
Est. 150,000 gallon Storage tank (bolted steel)		300,000
Est. Concrete foundation		60,000
Est. Access road and site improvements		100,000

Est. Booster pump station	140,000
Subtotal	3,152,000
Construction contingency (20%)	630,000
Subtotal	3,782,000
Planning, design, CM (25%)	948,000
OPINION OF PROBABLE PROJECT COST	$4,730,000

Comparison of Alternatives – The cost difference between the above two alternatives reflects the selection of storage tanks. Alternative A involves refurbishing the existing Woodland Heights storage tank and connecting it into the system serving West Ignacio to establish the second pressure zone. The Woodland Heights storage tank has good elevation but has a capacity of only 120,000 gallons, which is less than desirable for the projected water demands. The existing Woodland Heights tank in Alternative A is located on a 2,850 square foot lot which is smaller than a proper building site so that even if the tank were removed and the land were declared surplus it would only be useful to the immediate neighbor and probably would not be worth much.

Alternative B involves constructing a new storage tank on the College of Marin IVC property with a capacity of 150,000 gallons. This tank has a greater capacity than the Woodland Heights tank. The location of a new tank and pipeline routings would need to be worked out with the College.

Table 4 compares the NMWD metric for existing recycled water projects against the two alternative RW projects. For high water use the cost of recycled water under Alternative A is 136% of the metric for existing RW projects of $1,524/AF. The cost of RW under Alternative B is 151% of the metric. At the low water use the cost is over 200% of the metric for both alternatives.

TABLE 4 - COMPARISON OF ALTERNATIVE PROJECTS AGAINST NMWD METRIC FOR EXISTING RECYCLED WATER PROJECTS

Parameter	NMWD Metric for Existing RW projects	ALTERNATIVE A		ALTERHATIVE B	
		High RW use	Low RW use	High RW use	Low RW use
Total RW Cost	$30,788,388	$4,275,000	$4,275,000	$4,730,000	$4,730,000
Annual capital cost	$1,196,606	$166,150	$166,150	$183,830	$183,830
AF/YR at buildout	785	80	51	80	51
life cycle years	50	50	50	50	50
Discount rate	3%	3%	3%	3%	3%
$/AF	$1,524	$2,077	$3,258	$2,298	$3,605
% of Existing metric		136%	214%	151%	237%

It should be noted that it will be increasingly expensive to extend the recycled water distribution system beyond the high water use customers. It might be more appropriate to compare the cost

per acre foot of recycled water to the marginal cost of obtaining an equivalent amount of potable water that will be replaced.

COSTS OF CONNECTING TO THE RECYCLED WATER DISTRIBUTION SYSTEM

Requirements, conditions and procedures for conversion or establishment of recycled water service are set forth in Regulation 18 which was adopted on April 19, 2011 by NMWD Ordinance No. 24. After a determination is made that it is feasible to supply recycled water, the conversion of existing irrigation systems require separation of irrigation piping from potable water piping and installation of a backflow prevention device on the potable water supply. In some cases irrigation customers may need to install their own pumping system to obtain the necessary pressure for irrigation.

There are ten identified irrigation customers within Service Area S-4, ranging from three City medians and a HOA, which are very small and three large users. A very rough budget estimate of the retrofit costs is given in Table 5. NMWD typically pays for the retrofit of the existing irrigation system to use recycled water. The backflow prevention device and meters are typically not part of that process.

Retrofit Design – The design costs for retrofitting existing irrigation systems typically run from $3,500 - $10,000 depending on the size and complexity of the retrofit. The design costs for the smaller HOA or City median areas would be in the $3,500 range. The San Jose Middle School and City athletic field would likely be in the $10,000 range but might be higher if an onsite booster pump is needed.

Retrofit Construction – The construction costs can vary widely by site. For the smaller sites retrofit costs can run around $10,000. For larger sites the construction costs can be up to $30,000 or more depending on how far they have to run the line from the recycled water meter to the existing irrigation system. If an onsite irrigation booster pump is needed it could add

TABLE 5 – BUDGET ESTIMATE OF RETROFIT COSTS IN SERVICE AREA S-4

Small Users		
Design	4@$3,500	$14,000
Construction	4@$10,000	40,000
Medium Users		
Design	2@$5,000	10,000
Construction	2@15,000	30,000
Large Users		
Design	3@$10,000	30,000
Construction	3@$30,000	90,000
Miscellaneous		50,000
	TOTAL RETROFIT ESTIMATE	$264,000

another $25,000 to the retrofit cost. Being at a lower elevation the San Jose Middle School may not need a pump depending on the elevation of the Zone 2 storage tank. The City Athletic field is at a higher elevation and may need pumps, again depending on the elevation of the storage tank. IVC's plans for construction and landscape rehabilitation on the campus would typically include any necessary retrofit.

RECYCLED WATER PRODUCTION FOR THE NORTH/CENTRAL SERVICE AREA

Recycled water for the North and Central Service Areas is primarily produced at the recycled water treatment facility located at the NSD Davidson St recycled water facility. The original satellite recycled water treatment facility, which was built to serve the Stonetree Golf Course, is located at the NSD reclamation ponds and is now operated by NMWD as a backup facility.

Table 6 summarizes the projected recycled water usage in the North and Central Service Areas. Projections for the Stonetree Golf Course and the North Service Area (N-1 and N-2) customers are based on actual metered recycled water usage. Projections for the Central and Southern

TABLE 6 – NMWD PROJECTED RECYCLED WATER USAGE IN THE NORTH AND CENTRAL SERVICE AREAS

Service Area	Major user	Annual AF/yr	Peak Month gal/mo	Avg Day Peak Month, gpd	Peak Day gpd	Peak Hour gpm
On site storage						
E-1	Stonetree Golf Course	198.7	12,949,319	386,209	656,555	1,341
Pressure Zone 1 - Plum St Tank and Norman Tank - Total storage volume = 1,000,000 gallons						
N-1	Incl. Fireman's Fund	116.16	7,570,170	252,339	428,976	876
N-2	Incl. Valley Memorial Park	54.64	3,560,900	118,697	201,784	412
C-1	Central Novato	33.69	2,195,584	73,186	124,416	254
C-2	South Central Novato	175.74	11,453,011	381,767	649,004	1,326
C-3 ptn	Lynwood School only	62.19	4,052,935	135,098	229,666	469
S-2 ptn	Villa Entrada 520 Entrada	6.39	416,438	13,881	23,598	48
S-3	Incl. Marin Country Club Golf Course	125.16	8,156,702	271,890	462,213	944
	SUBTOTALS	772.67	50,355,058	1,678,502	2,853,453	5,828
Pressure Zone 2 – Total storage volume = 120,000 gallons to 150,000 gallons						
S-4	San Jose Middle School and COM IVC					
	High	79.94	5,209,706	173,659	295,217	603
	Low	51.24	3,339,321	111,311	189,228	386
TOTAL RECYCLED WATER DEMAND IN THE NORTH AND CENTRAL SERVICE AREAS						
	High	852.61	55,564,764	1,852,161	3,148,670	6,431
	Low	823.91	53,694,379	1,789.813	3,042,682	6,214

(C and S) Service Areas are based on projections in Reference 1. On the basis of these projections the average day in the peak month the recycled water demand will be 1.8 mgd and the peak dry weather around 3.0 mgd.

In 2015, the NMWD and NSD conducted a study (Reference 6) to identify possible expansion needs of the NSD Davidson St recycled water facility to meet the expected recycled water usage as the distribution lines are extended from the North Service Area into the Central Service Area. This Draft Final Technical Memorandum, dated December 21, 2015 entitled "Recycled Water Facility Expansion – Basis of Design" by RMC, recommended expansion of the recycled water treatment facility at the Davidson St plant by installing a third filtration unit. As shown in Table 7 this will increase the facility's current firm capacity from 0.85 mgd to 1.7 mgd with a maximum recycled water production rate (all units running) of 2.92 mgd. This expansion project is scheduled to bid in the Fall of 2017. NSD is also planning a future additional expansion as part of the North Bay Water Recycling Authority (NBWRA) Phase 2. The Deer Island filtration units which were originally installed to serve the Stonetree Golf Course will be decommissioned.

When fully connected the recycled water demand from the West Ignacio Service Area (Service Area S-4) will exceed the firm treatment capacity of the Davidson St facility by around 6%. In order to make up this difference it may be necessary to run all filtration units more frequently. The Davidson St recycled water treatment facility also has 370,000 gallons of storage which can be used as a buffer to attenuate diurnal demands.

TABLE 7 – RECYCLED WATER TREATMENT CAPACITY

Facility	Firm Capacity (duty units running)	Maximum Capacity (all units running
NSD Davidson St facility as expanded	1.7 mgd	2.92 mgd
PROJECTED REQUIRED CAPACITY	1.79 - 1.81 mgd	3.05 – 3.07 mgd

POSSIBLE GRANT AND LOAN FUNDING

In previous recycled water projects NMWD has been successful in obtaining outside grants and loans for some of the capital costs. Federal and State grant and loan funds for recycled water projects are occasionally authorized by Congress, the State legislature or by a voter initiative and are available until the funds are exhausted. In some programs funds are replenished as loans are repaid.

The State of California Water Recourses Control Board has established a Water Recycling Funding Program which helps agencies with obtaining financial assistance for capital water recycling projects. Some of the funding sources include:

- State of California Clean Water State Revolving Fund provides loans at below market interest rates for qualified projects, including water recycling facilities. As these loans

are repaid funds are returned to the program and can be loaned out again. The program is currently oversubscribed but by mid-2020 more money should start to become available.

- State of California Proposition 1 is a newer grant program and authorizes $625 million for water recycling funding and is administered by the State Water Resources Control Board Water Recycling Funding Program.
- State of California Propositions 13, 50 and 84 are older grant and loan programs and the funding availability comes and goes.
- US Bureau of Reclamation Title XVI of PL 102-575 as amended provides authority for Reclamation's water recycling and reuse program. Title XVI includes funding for the planning, design, and construction of water recycling and reuse projects, on a project specific basis, in partnership with local government entities.

Most of these grant and loan programs are competitive. Projects which are already designed and "shovel ready" are more likely to receive funding as other projects may not be ready and fall away.

SUMMARY

The West Ignacio Service Area S-4 includes ten active irrigation customers including three City medians, a City park and two athletic fields, a vegetable garden and the College of Marin IVC. A Master Plan is currently being developed for upgrading the IVC and will include new irrigated areas. The projected irrigation water consumption in Service Area S-4 after the IVC is fully upgraded is estimated between 51 and 80 acre feet per year and the average day consumption during the peak month is projected to be between 111,000 and 174,000 gallons. Peak daily demand can run as high as 289,000 to 295,000 gallons.

A new recycled water distribution pipeline has been constructed from the NSD Davidson St recycled water treatment facility to serve Central Novato and East Ignacio as far as the Marin Country Club Golf Course. Extension of recycled water service to Service Area S-4 in West Ignacio area will involve constructing approximately 1.6 miles of pipeline in Ignacio Blvd, a booster pump station and a storage tank together with its connecting pipeline. The storage tank is necessary to establish a second pressure zone and allow off-peak filling.

The opinion of probable project cost to extend the recycled water distribution system to serve the West Ignacio area ranges from $4,275,000, if the Woodland Heights storage tank is reconditioned to $4,650,000, if a new storage tank is constructed. The design and construction of the necessary retrofit equipment for existing irrigated areas is estimated to cost an estimated $264,000.

RECOMMENDATION

It is recommended that Alternative A be selected as the most cost effective project. This alternative will utilize the existing Woodland Heights storage tank which has a capacity of 120,000 gallons. This storage capacity will be sufficient for a recycled water volume midway between the high and low water usage. The lower water usage will likely be realized if synthetic turf is installed in one or more sites. Alternative B which involves constructing a new storage tank on COM property is more expensive and may be more difficult to implement because siting a new tank is involved.

The projected capital cost per acre foot of the recycled water for both of these alternatives exceeds the metric for the existing NMWD recycled water projects. Financial contributions by some of the major irrigation water users such as the College of Marin as well as possible grant funding would be helpful with implementation of this project.

REFERENCES

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4. Nute Engineering, *Feasibility Study to Provide Recycled Water to the Marin Country Club Golf Course Update*, North Marin Water District, May 2014
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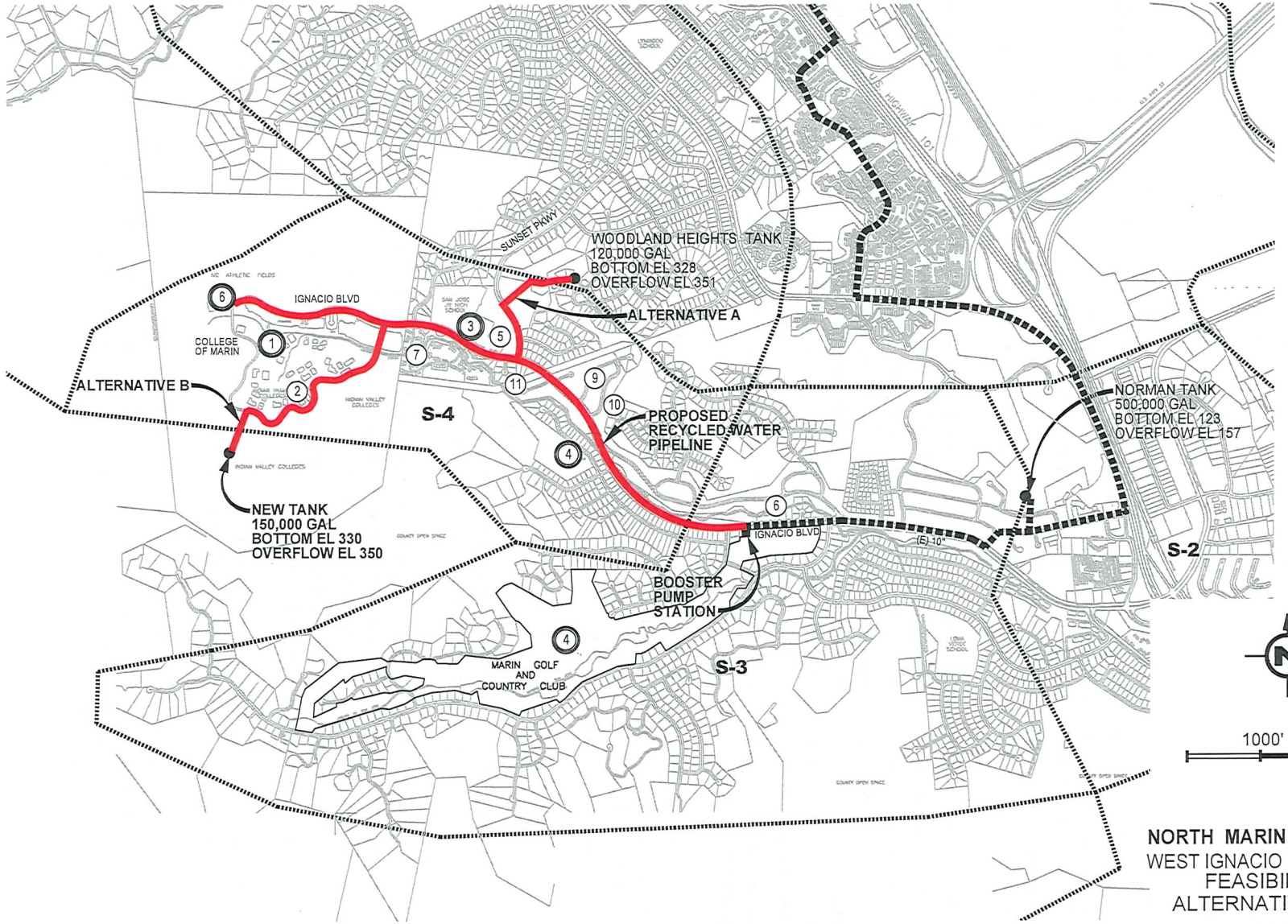
6. RMC, *Draft Final Technical Memorandum*, North Marin Water District/ Novato Sanitary District, Recycled Water Facility Expansion – Basis of Design, December 21, 2015



NORTH MARIN WATER DISTRICT
WEST IGNACIO RECYCLED WATER
FEASIBILITY STUDY
ALTERNATIVE PROJECTS

FIGURE 1

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APPENDIX A

Updated Excerpt from NMWD and NSD WATER RECYCLING STUDIES, November 1991, SECTION II – WATER RECYCLING FEASIBILITY

WATER QUALITY GUIDELINES FOR IRRIGATION USE

In addition to the health regulations, the suitability of recycled water for irrigation of landscaping is dependent on its chemical characteristics. Recycled water contains higher concentrations of impurities than does potable water, and thus careful consideration must be given to its water quality in order to minimize the possible long-term effects of salts, nutrients and trace elements on plants and soils. These effects are normally manageable if problems associated with these impurities are understood and allowance is made for them.

The primary water quality factor which could adversely affect plants or create agronomic problems for certain soils is the quantity and kind of salt present in the recycled water or an excessive concentration of one or more trace elements. These problems are no different than those caused by salinity or trace elements in freshwater supplies and are of concern if they restrict the use of the water or require special management. In the Novato area, some wastewater collection systems are near the bay, and there is a potential for salt and contaminants to enter the wastewater. Rigorous regulations and programs must be maintained in order to assure that introduction of salt and deleterious concentrations of contaminants be controlled at the source.

Factors associated with agronomic problems from water use are listed below, and Table II-2 gives their threshold limits for various degrees of restriction on use along with a comparison with the effluent quality from the recycled water furnished by the NMWD from the NSD Davidson St. treatment plant.

- High salt concentrations can cause plant stalking, leaf burn, leaf drop, stem dieback and may lower frost resistance. Water with a total dissolved solids (TDS) concentration of less than 450 mg/l is considered to have no restriction on use. The average TDS in the NMWD recycled water is 506 mg/l.

- Most tree crops are sensitive to sodium and chloride. Where sodium and chloride exceed 70 to 100 mg/l, overhead sprinkler irrigation with low humidity (<30%) can result in excessive leaf absorption and damage to sensitive agricultural crops. The sodium concentration in the NMWD recycled water averages 103.4 and the chloride concentration averages 125 mg/l.

- High levels of boron can cause leaf burn. Boron levels of 0.7 to 3.0 mg/I will have a slight to moderate effect on plants.

- Sodium absorption ratio (SAR) is a calculated value of the probable influence the sodium ion has on soil permeability, i.e., the infiltration of water into the soil. The effect of SAR is related to the salinity of the water. The formula for the sodium absorption value is

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

The SAR in the NMWD recycled water averages 3.69. As shown in Table II-2 with low salinity water, this SAR will have essentially no restriction on soil permeability.

- Nutrients in recycled water, which include nitrogen, phosphorous, potassium and recommended micronutrients, are generally beneficial to plant growth. Usually there is not enough potassium available in recycled water so that supplemental fertilization may be required. Nitrogen may often be higher than would normally be applied and can produce increased vegetative growth and reduced fruiting, which for landscape plantings is generally manageable. As shown in Table II-2 nitrogen in irrigated water below 5 mg/I causes no problems; problems increase with concentrates between 5 and 30 mg/I; and severe problems can occur if the nitrogen concentration exceeds 30 mg/I. The nitrogen concentration in the NMWD recycled water averages 14.7 mg/l.

The quality of the recycled water furnished by NMWD from the NSD Davidson St. treatment facility can generally be characterized as having only slight restriction on irrigation use. The Total Dissolved Solids (TDS), sodium absorption ratio and chlorides for surface irrigation, do not provide any restriction on use. The conductivity (ECw), soil permeability, sodium and chloride for sprinkler irrigation show only a slight restriction on use.

The nitrogen concentration shows a moderate to severe restriction on use and could affect certain agricultural crops. As discussed above high nitrogen causes increased vegetative growth, and crops like hay, other forage crops, and landscaping plantings can tolerate and even benefit from large amounts of nitrogen and can save substantial fertilizing costs. The high nitrogen concentration will also promote algae growth when the recycled water is stored in open ponds.

In summary, the NMWD recycled water produced by the NSD Davidson St. treatment plant poses very little problem for landscape irrigation use.

APPENDIX A - TABLE II-2
COMPARISON OF WATER QUALITY GUIDELINES FOR IRRIGATION USE
TO NMWD RECYCLED WATER FROM THE NSD DAVIDSON ST. TREATMENT PLANT

Potential Irrigation Problem	Degree of Restriction on Use			NMWD Recycled Water (avg blended) NSD Plant	Degree of Restriction
	None	Slight to Moderate	Severe		
Salinity (affects crop availability					
EC_w Conductivity, mmho/cm	<0.7	0.7-3.0	>3.0	0.73 - 1.02	slight
TDS (Total Dissolved Soids), mg/l	<450	450-2000	>2000	461 - 540	slight
Soil Permeability (affects infiltration rate of water into the soil. Evaluated using EC_w and SAR together)					
SAR = 0-3 and EC_w	= >0.7	0.7-0.2	<0.2		
= 3-6	= >1.2	1.2-0.3	<0.3	0.73 - 1.02	none
= 6-12	= >1.9	1.9-0.5	<0.5		--
= 12-20	= >2.9	2.9-1.3	<1.3		--
= 20-40	= >5.0	5.02.9	<2.9		--
Specific ion toxicity (affects senstive crops)					
Sodium (Na)					
Surface irrigation, SAR	<3	3-9	>9	2.26 - 4.73	slight
Sprinkler irrigation, Na mg/l	<70	>70		59 - 138	slight
Chloride (Cl)					
Surface irrigation, Cl mg/l	<140	140-350	>350	106 - 149	slight
Sprinkler irrigation, mg/l	<100	>100		106 - 149	slight
Miscellaneous effects (affects susceptible crops)					
Nitrogen (Total-N as N), mg/l	<5	5-30	>30	11.1 - 16.9	slight
pH	Normal range 6.5 - 8.4			7.1 - 7.6	normal