Appendix A

Woodacre Creek and San Geronimo Creek Microbial Source Tracking

Woodacre Creek and San Geronimo Creek
Microbial Source Tracking - Winter 2016 to Summer 2017

Results

January 2018

Water samples were collected in collaboration with the Marin County Environmental Health Services, Marin Municipal Water District, Tomales Bay Watershed Council, the Woodacre/San Geronimo Wastewater Group, and the San Geronimo Valley Planning Group. Funding was provided by the San Francisco Bay Area Regional Water Quality Control Board. Study design was prepared by the County and Water Board staffs. Lab analysis was performed by Cel Analytical.

<u>Sample Sites</u>

Water samples were collected from the following sites:

- Woodacre Creek just above the confluence with San Geronimo Creek (SWAMP 210LAG300)
- San Geronimo Creek just above confluence with Woodacre Creek (SWAMP 201LAG350)
- San Geronimo Creek under the Meadow Way Bridge (SWAMP 201LAG260)

<u>Sample Events</u>

Grab samples were collected from each of the above sites during the following conditions.

1. **Winter season – December 16, 2016**: Nearly three inches of rain fell within 48 hours prior to sampling. The creek level was extremely high from recent storm. The reference stream (see note below) flow was approximately 400 ft3/sec.

2. **Winter Season – February 15, 2017**: Although there was no rain within four days of collecting samples, 6.6 inches of rain fell during the previous two weeks. The reference stream flow was approximately 165 ft3/sec

3. **Spring – May 10, 2017**: There was no reported rain within 2 weeks of sampling, when there was 0.125 inches of rain. The reference stream flow was approximately 12.4 ft3/sec.

4. **Summer - July 20, 2017**: There was no reported rainfall in the preceding month. There was only a small flow from San Geronimo Creek above the confluence with Woodacre Creek. The reference stream flow was 8.5 ft3/sec.

Rainfall: The nearest rainfall measurements were from Point Reyes Station, approximately 15 miles west of the project area. The accumulated rainfall from Oct 1, 2016 was 45.6 inches. The accumulated rainfall from Kentfield, approximately 15 miles to the east was 82.9 inches.

Stream Flow: The nearest recorded stream flows were from Samuel P. Taylor Park and is provided for reference only.

Field duplicates were collected at Woodacre Creek during the first, third, and fourth sampling event, and analyzed for all markers. A fourth field duplicate was taken at the upstream site on San Geronimo Creek during the second event, and analyzed for all markers.

Laboratory duplicate were run for all markers at the first and fourth sampling event at the upstream site on San Geronimo Creek, and at the third sampling event at Woodacre Creek. Results of the field and lab duplicates were consistent with the primary analysis for all markers.

Sampling Parameters

Microbial Source Tracking was used to detect the presence of host-specific *Bacteroides* bacteria from different host sources within the Woodacre/San Geronimo Creek watershed. Given the characteristics of the watershed, analysis was performed for universal, human, horse, ruminant, and dog *Bacteroides* markers. Marker analysis was conducted using quantitative polymerase chain reaction (qPCR). Each grab sample was also analyzed for *E. coli.*

Limits of Detection

Lab results for bacteroidales qPCR are presented with the following Quality Control (QC) terminology and qualifiers:

LOD Limit of Detection. This is the lowest point on the standard curve.[1]

LLOQ Lower Limit of Quantification. This is a lab reporting limit.

DNQ Detected but Not Quantifiable. This qualifier is used for signals between LOD and LLOQ.

DBLOD Detected Below Limit of Detection. This qualifier is used for signals detected below LOD.

ND Not Detected (no detectable signal for the sample). The value associated with ND is zero.

Results

There are no standard threshold levels for interpreting MST results. One way to analyze the results is to consider a marker to be positive when the result is above the Limit of Detection. Looking at the results this way shows strong hits for the human marker in Woodacre Creek (100%), San Geronimo Creek at Meadow Way (75%), and San Geronimo Creek above Woodacre Creek (50%). Positive results were also found for horse (25%, 50%, and 25% respectively), ruminant (0%, 25%, and 25%), and dog (25%, 25%, and 0%.) These results are presented in Tables 1 and 2.

However, given the sample size and the inherent nature of the analysis, results can also be interpreted more on trends and a presence from particular sources than on quantitative results alone. To consider results in this way, any lab signal greater than zero (ND) can be considered a positive hit for a marker; this includes results that are DBLOD. Looking at all sample sites this way indicates 75-100% positive for human markers, 50-75% for horse, 25-100% for ruminant, and 25-50% for dog. Table 3 summarizes results in this way.

Human fecal waste was present in Woodacre Creek and the Meadow Way/San Geronimo Creek sites during all four events. The highest levels were during the rainy season, particularly after a heavy rain.

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[1] A standard curve is generated from analyses of serial dilutions of control DNA using the Bacteroidales species-specific primers and probe assay. LOD is the lowest point on the standard curve reproducibly detected by the lab.

The human marker (HF183)[1] was detected at all of the first three events on upstream San Geronimo Creek, except in the summer when there was little flow.

Horse waste was detected at each station during two to three events, but levels were higher in the spring and summer during lower flows. No horse marker was detected at any station during the first wet season sample. During the second wet season event, horse marker (HoF597)[2] was present at a low level. Horse markers are present at all three sites during the summer low flow. The highest strength of horse marker was in the spring at the Meadow Way/San Geronimo Creek site.

Low levels of ruminant (cattle and deer) were detected at all four events at Meadow Way/San Geronimo Creek. Ruminant were detected in the summer only in Woodacre Creek at a low level. At the upstream San Geronimo Creek site, the ruminant marker (Rum2Bac)[2] was detected during the first, second, and fourth event at slightly higher levels than the other stations; this is consistent with the nature of cattle grazing in this portion of the watershed. However, it is noted that the ruminant marker Rum2Bac may not be appropriate for this watershed. Ruminant markers may perform differently in different regions based on variations in the animal populations and the regional husbandry practices such as the animal subtypes, their diet, antibiotic administration, etc. At this time, the lab is working on a better marker for ruminants and may be able to retest some of the collected samples.

Dog waste was detected at least once at each station, but only during the wet season samples in December and February. The highest level of dog marker (DogBact)[2] was in Woodacre Creek after the large December storm.

E.coli results did not appear to correlate with the presence or strength of human marker.

The TMDL for Tomales Bay calls for no discharge of human waste into tributaries of Lagunitas Creek. The results of this study underscore the presence of human fecal waste in Woodacre and San Geronimo Creeks. While there is also horse, ruminant, and dog waste, the presence of human waste is the most consistent; this is particularly troubling since it indicates the potential presence of human pathogens posing a threat to public health.

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[1] Improved HF183 Quantitative Real-Time PCR Assay for Characterization of Human Fecal Pollution in Ambient Surface Water Samples: May 2014 Hyatt C. Green, Richard A. Haugland, Manju Varma, Hana T. Millen, Mark A. Borchardt, Katharine G. Field, William A. Walters, R. Knight, Mano Sivaganesan, Catherine A. Kelty, Orin C. Shanks - Applied and Environmental Microbiology p. 3086–3094 Volume 80 Number 10.

[2] The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches: December 2013- John F. Griffith, Blythe A. Layton, Alexandria B. Boehm, Patricia A. Holden, Jennifer A. Jay, Charles Hagedo, Charles D. McGee and Stephen B. Weisberg- Southern California Coastal Research Project Technical Report 804- Appendices.

TABLE 1

Woodacre/San Geronimo Creek

Microbial Source Tracking

Sponsored by SFRWQCB

Lab Analysis: Cel Analytical

Marker	Woodacre Creek above Confluence with San Geronimo Creek				San Geronimo Creek above Confluence with Woodacre Creek				San Geronimo Creek under Meadow Way			
	12/16/16	2/15/17	5/22/17	7/20/17	12/16/16	2/15/17	5/22/17	7/20/17	12/16/16	2/15/17	5/22/2017	7/20/2017
Human	Positive	Positive	Positive	Positive	Positive	Positive	Detected	No Detect	Positive	Positive	Detected	Positive
Horse	No Detect	Detected	No Detect	Positive	No Detect	Detected	Detected	Positive	No Detect	Detected	Positive	Positive
Ruminant	No Detect	No Detect	No Detect	Detected	Positive	Positive	No Detect	Detected	Detected	Detected	Detected	Detected
Dog	Positive	No Detect	No Detect	No Detect	No Detect	Detected	No Detect	No Detect	Detected	Positive	No Detect	No Detect

Positive	Results above the Limit of Detection (LOD)
Detected	Results Detected Below Level of Detection (DBLOD) or Detected but Not Quantifiable (DNQ). Non-zero signals below LOD
No Detect	Not Detected, no detectable amplification for the sample

10/24/2017

TABLE 2

Woodacre/San Geronimo Creek

Microbial Source Tracking Summary Results

December 16, 2016
February 15, 2017
May 22, 2017
July 20, 2017

	Woodacre Creek above Confluence with San Geronimo Creek (201LAG300)		San Geronimo Creek above Confluence with Woodacre Creek (201LAG350)		San Geronimo Creek under Meadow Way (201LAG260)	
Marker	Positives	Detected	Positives	Detected	Positives	Detected
Human	100%		50%	25%	75%	25%
Horse	25%	25%	25%	50%	50%	25%
Ruminant		25%	25%	25%		100%
Dog	25%			25%	25%	25%

Positive	Results above the Limit of Detection (LOD)
Detected	Results Detected Below Level of Detection (DBLOD) or Detected but Not Quantifiable (DNQ).
No Detect	Not detected; no detectable amplification for the sample

TABLE 3

Woodacre/San Geronimo Creek

Microbial Source Tracking

December 16, 2016
February 15, 2017
May 22, 2017
July 20, 2017

This table presents positives as any signal greater than zero; this includes results Detected Below Level of Detection and Detected but Not Quantifiable.

	Woodacre Creek above Confluence with San Geronimo Creek (201LAG300)	San Geronimo Creek above Confluence with Woodacre Creek (201LAG350)	San Geronimo Creek under Meadow Way (201LAG260)
Marker	Percent positives	Percent positives	Percent positives
Human	100%	75%	100%
Horse	50%	75%	75%
Ruminant	25%	75%	100%
Dog	25%	25%	50%

Concurrent Microbial Source Tracking Analysis using PhyloChip

Duplicate water samples were also collected and analyzed by Lawrence Berkeley Laboratory using PhyloChip analysis. This collaborative effort was funded by the San Geronimo Valley Planning Group.

Principal investigator Dr. Eric Dubinsky summarized these results: *"PhyloChip analysis of the San Geronimo Creek samples found strong fecal signals from human sources in five samples, ruminant in one sample and dog in one sample. Marginal fecal signal from human was detected in six samples, ruminant in two samples, horse in two samples and bird in two samples. Fecal signals were more frequently detected in wet season months (December and February), with the notable exceptions of a strong human signal in Montezuma Creek (site 10) in May and dog in an unnamed tributary to Woodacre Creek at 55 Park Rd (site 8) in July." -November 28, 2017*

The comparative results of the two separate methods is presented in the following table.

Woodacre/San Geronimo Creek
Microbial Source Tracking and PhyloChip

Sponsored by SFRWQCB
MST Lab Analysis: Cel Analytical
PhyloChip Analysis: Lawrence Berkeley Laboratory/UC Berkeley

Marker	Woodacre Creek above Confluence with San Geronimo Creek (LBL Station 2)				San Geronimo Creek above Confluence with Woodacre Creek (LBL Station 3)				San Geronimo Creek under Meadow Way (LBL Station 1)			
	12/16/16	2/15/17	5/22/17	7/20/17	12/16/16	2/15/17	5/22/17	7/20/17	12/16/16	2/15/17	5/22/2017	7/20/2017
E. Coli	816	161	214	66	2420	131	127	12	921	150	461	56
Human MST	541	136	8 DNQ	39	85	57	2 DBLOD	0	438	14	3 DBLOD	22
Human MST	Positive	Positive	Positive	Positive	Positive	Positive	Detected	No Detect	Positive	Positive	Detected	Positive
Phylochip	0.38	0.22	0.03	0.07	0.20	0.05	0.01	0.03	0.28	0.15	0.01	0.00

Horse MST	No Detect	Detected	No Detect	Positive	No Detect	Detected	Detected	Positive	No Detect	Detected	Positive	Positive
Phylochip	0.11	0.04	0.02	0.04	0.11	0.05	0.00	0.01	0.09	0.04	0.01	0.01
Ruminant MST	No Detect	No Detect	No Detect	Detected	Positive	Positive	No Detect	Detected	Detected	Detected	Detected	Detected
Phylochip	0.06	0.03	0.02	0.04	0.22	0.08	0.01	0.02	0.15	0.07	0.01	0.01
Dog MST	Positive	No Detect	No Detect	No Detect	No Detect	Detected	No Detect	No Detect	Detected	Positive	No Detect	No Detect
Phylochip	0.04	0.02	0.03	0.05	0.04	0.03	0.01	0.02	0.04	0.02	0.01	0.01

	Exceeds *E. coli* standard
Positive	Results above the MST Limit of Detection (LOD) and PhyloChip 0.20 and above
Positive	PhyloChip results between 0.1 and 0.2 indicates marginal source
Detected	MST Results Detected Below Level of Detection (DBLOD) or Detected but Not Quantifiable (DNQ). Non-zero signals below LOD
No Detect	For MST, no detectable amplification for the sample; for PhyloChip, result less than 0.1

Human Marker LOD = 6 gc/mL
Humna Marker LLOQ = 12 gc/mL

0 = Non detect
DBLOD = Detected below level of detection
DNQ = Detected but not quantifiable

Appendix B

Onsite System Survey Information

- 2004-2005 Septic Matters Program
- 2010 Questa Field Reviews

2004-2005 Septic Matters Program

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April 8, 2008

The Septic Matters Program

A Survey of Septic System Conditions in the Tomales Bay Watershed

Background
Contaminants relating at least in part to septic systems were found in Tomales Bay and in tributaries that flow into the Bay. Salmon spawning is known to occur in some of the tributaries. Marin County Environmental Health Services applied for grants to survey the condition of septic systems in close proximity to the Bay and to waterways in the Tomales Bay watershed. Grants were provided through the State Water Resources control Board and the Coastal Conservancy and inspections were made in the communities of Forest Knolls (19), Inverness (18), Lagunitas (13), Marshall (2), Nicasio 2), San Geronimo (8), Petaluma (2), Point Reyes Station (9), and Woodacre (62 – note an active community group encouraged participation).

As owner permission to review and test individual septic systems would have been unlikely, the Septic Matters Program was devised by Marin County Environmental Health (EH) to provide community education to homeowners while offering a free and confidential third party inspection and testing of the systems. It was felt that education regarding the function of septic systems and the impacts of failing or marginal systems would be a valuable foundation to the program. Additional site specific education was provided to individual homeowners who voluntarily requested septic system inspections. Inspection data labeled by community was provided to Marin County minus the specific address of the residence. A total of 135 inspections were done between 1/26/04 and 3/22/08. (Eleven additional inspections were made in Bolinas and Novato which are outside of the Tomales Bay watershed.)

From 1/26/04 to 1/31/06, 98 inspections (87 in the watershed) were made by Kit Rosefield, a septic system inspector with certifications through both the National Sanitation Foundation (NSF) and the National Association of Wastewater Transporters (NAWT). Kit held 18 Septic Social educational workshops in four different communities. When Mr. Rosefield moved his business to Tuolumne County, EH asked me to perform additional inspections. I was able to complete 48 septic system reviews from 12/3/07 to 3/22/08. My experience consists of nearly 30 years in onsite wastewater practice with both San Diego and Sonoma Counties, with the last seven years in private practice. I left Sonoma County in 2001 as Supervisor of the Well and Septic Division and am also a NAWT certified inspector. Kit Rosefield and I are both instructors for NAWT through the California Onsite Wastewater Association.

During the inspections, a number of problems were discovered, including failing systems, leaking tanks, failed pumps, and inoperational equipment. A combination of education, suggestion and assistance for repairs led to a number of corrections which has, at least in some way, contributed to beneficial effects on the quality of the ground and surface waters of the watershed.

Goals

The program was set up to offer community and individual homeowner septic system education and to provide a sampling of the condition and function of septic systems in close proximity to the Bay and to water ways of the Tomales Bay watershed. In addition, suggestions and assistance for system repair and improvement were to be provided.

Process

Through community educational meetings, newspaper ads, interested community groups, real estate office flyers and word of mouth, appointments were made at the request of homeowners to inspect their septic systems. Prior to meeting with homeowners, we pulled copies of septic system permits and plot plans from EH and provided those, where available, for the owner. I estimate that some level of septic system records were available for about 2/3 of the homes. Some people did not know what their system was comprised of or where some components were located. At that time, we offered educational materials and County lists of pumping firms, contractors and designers. We discussed needed repairs and offered suggestions as to how to what professional groups were most suited to do them. Common suggestions were for the replacement of tanks or systems, installation of fiberglass surface risers and effluent filters, tank pumping, and hook-up of surface graywater lines back into the septic tank.

Inspections were made, where possible, of the tanks, pump tanks, and any components of the system accessible from the surface such as valves and monitoring wells. A hydraulic load test meeting Marin County standard Memorandum #1 was performed where possible. Written reports were generated, usually on site, and handed to the homeowner. No copies were kept, giving increased credence to the confidential nature of the inspection. General information by community, minus specific addresses, was kept on spreadsheets (attached) for Marin EH.

As inspections came from voluntary homeowner requests, a truly random sampling program was not available. I believe, however, that given the similar site characteristics, system ages, and lot sizes for a majority of the homes, the findings offer a reasonably valid snapshot of overall conditions in some of these communities.

Onsite Wastewater Issues Observed in the Survey

1. *System Age* – The majority of the houses were from the turn of the century through the 1970's. Newer homes with more modern systems were in the minority. In relation to the average system lifespan generally estimated at thirty years, most of the systems viewed were 30-50 years old. Many of the system owners noted repairs had been done, most often without permits.
2. *Small Parcels* – As is often seen in older subdivisions, many of the lot sizes are small, often ranging from 8-15,000 square feet. The lots were often overdeveloped with homes, garages, driveways, decks, pools and other hardscape in relation to the space given to the septic system. There was often little or no fail safe or system replacement area remaining.
3. *High Groundwater (GW)* – Valley floor and flatter areas (such as Railroad Avenue in Woodacre tend to have high seasonal GW. I observed GW as high as 4 inches and many sites at 16-18 inches from the surface. These elevations typically flood both gravity septic tanks and dispersal fields that may be 3-6 feet deep. It is documented that such saturated soils provide for transmission of pathogenic organisms up to 1,000 feet. Anecdotal reports of heavy rain sheet flow were also mentioned by some homeowners.

4. *Small Systems* – Many of the systems are smaller or substantially smaller than would be required under today's more scientifically based standards. These conditions will likely result in faster accumulation of clogging bio-mat and a reduced system lifespan. In addition, smaller systems are more subject to hydraulic overload.
5. *Marginal or Shallow Soils* – In discussions with EH staff and anecdotal talks with homeowners, many of the area's soils are shallow or marginal, with standards gravity systems (the most common type found) poorly suited for adequate dispersal under these conditions.
6. *Additional Living Units* – Secondary living units were seen at 10-20% of the residences inspected, some existing without permits. This increases wastewater volume and stresses on existing systems.
7. *Proximity to Waterways* – Many systems are closer to waterways than current standards would allow, creating increased potential for contaminant transmission.
8. *Graywater Discharges* – A number of homes discharge graywater (laundry, showers, sinks) to the ground surface, ditches, or to unpermitted gravel filled sumps. As graywater carries pathogens, this increases the possibility of contaminants being carried offsite. This is done to relieve pressure on marginal or failing septic systems or occasionally by owners pro-actively reducing the load on their systems.
9. *Limited or No Fail Safe* – Most properties had limited or no system replacement area, especially if current set backs from wells, waterways and structures were enforced.
10. *Reduced Access to Tanks* – Development such as decks and pavement stones have limited reasonably easy access to some tanks for pumping and diagnosis, resulting, in my opinion, in less frequent or no pumping and diagnostic checks of those tanks.
11. *Mosquito Breeding* – This was noted in several tanks or pump tanks with inadequate or poorly fitting concrete, fiberglass or wooden lids.
12. *Unpermitted Repairs* – A high percentage of repairs (Kit Rosefield estimated 60%) have been made without permits, leading to questions of adequate repairs and reasonable setbacks. Anecdotally, homeowners were afraid that if they sought permits, the County might reject them or require an unaffordable system. Also, there were concerns that the County may view other unpermitted work or second dwelling units and cause further problems. For some, it was an issue of philosophically not desiring any contact with governmental representatives. Some noted when there are problems with those repairs; however, the installer is often not interested in returning calls or correcting their work.
13. *Pre-code Tanks* – A modest percentage of tanks are redwood or, more rarely, bottomless, and are more likely to act like cesspools with reduced treatment and retention.
14. *Appropriate Repairs* – Most repairs have been "more of the same" gravity leach lines. With high GW and small spaces, the most appropriate repairs would be Bottomless Sand Filters, Mounds, or Advanced Treatment with Drip systems (on steeper slopes). These nonstandard type systems generally appeared to be functioning properly during the inspections. With price tags estimated at $40-60,000, they are not well accepted by homeowners. In addition, Bottomless Sand Filters and Mounds may take up much or all of the available recreational space on a small property, an issue also not well accepted. Many such nonstandard systems we observed were required as the result of a property transfer negotiation or as a County requirement for a new house, additional bedrooms or a major remodel.

Although not a registered geologist, my work of nearly 30 years in this field with geologists and hydro geologists alerts me to note the obvious geological setting of these valleys. Essentially all surface and subsurface wastewater discharges in the valley settings experienced in this study eventually drain to the tributaries which in turn feed Tomales Bay.

Findings – Septic Tank and Dispersal Systems (135)

	Septic Tank		Dispersal Systems	
	#	%	#	%
Acceptable	82	61	80	59
Unacceptable	39	29	42	31
Unknown/NA	14	10	13	10

Please see the Appendices section for definitions of Acceptable, Unacceptable and Unknown. A point here is that there were 14 tanks that could not be examined.

Findings – Hydraulic Load Testing (135)

	#	%	As a % of those actually tested
Excellent	17	12.5	20
Good	40	30	48
Satisfactory	4	3	5
Satisfactory / Marginal	4	3	5
Marginal	3	2	4
Poor	4	3	5
Failed	11	8	13
Unknown / N/A	52	38.5	--

Please see the Marin County EH Memorandum #1 for definitions and testing procedure. A point here is the high number of tests which could not be performed to flooded leaking tanks, failed pumps, access or other problems. Of 135 systems, only 83 could be tested. Many of those not tested would have been considered Failed if we had chosen to test an already unacceptable dispersal system or flooded tank.

Assumptions

The basic site conditions are unlikely to change: small parcels, high GW, often marginal soils, close proximity to waterways, limited replacement area, and seasonally saturated soil transmission of contaminants.

With the status quo, conditions that are unlikely to change or that may worsen with time are aging (deteriorating) systems, small systems, graywater or other discharges, unpermitted system repairs and remodeling, mosquito breeding, reduced access to tanks, and creek contamination.

Approximately half the inspections were done during the dry months (May through September). It is surmised that if all the inspections were done during wet weather periods, the rate of systems classified as failures would have been higher due to elevated winter GW and saturated soils.

Conclusions

A problem exists with many older systems in the Tomales Bay Watershed. Although some of the communities we visited had too few inspections requested to form a valid conclusion, there seems to be a pattern with the older systems and smaller parcels. Systems will continue to age, resulting in an increasing risk for surface and subsurface contamination of waterways. There appear to be two main categories of solution whose engineering realities, environmental issues, cost and benefit remain to be studied in more detail. The first is the construction of onsite improvements, with the main impediments as discussed being cost and available parcel space. The second potential solution would be a local community decentralized system or other public sewer. A properly sited community system would likely do more to keep wastewater from eventually ending up in the Bay after public sewer treatment. It is my experience that the common sewerage option has more ability to draw the grants or subsidies that would almost certainly be needed for either of the options.

Respectfully submitted,

Mike Treinen,
California Registered Environmental Health Specialist # 3826

APPENDICES

ABBREVIATIONS USED, DEFINITIONS, & INSPECTION SPREADSHEETS

Abbreviations and Definitions

Date
The date of inspection

Vicinity
Community in which the inspection was performed

Proximity to Waterway
Approximate distance from the septic tank and dispersal field to the bank of the waterway

Type of Waterway
A. *Perennial* – Year-round creek or waterway
B. *Ephemeral* – Seasonal flow in natural creek or waterway
C. *Intermittent* – Natural or manmade drainage courses feeding creeks or waterway
D. *Embayment* – Bay, tidal slough or estuary

Septic Tank Type
Block - Cinder block
Con - Concrete
FG - Fiberglass
Pla - Plastic
Rdw - Redwood

Septic Tank Condition
A - Acceptable – No significant deterioration; approved materials (concrete, fiberglass, plastic); major internal components in place
U - Unacceptable – Significant deterioration; unapproved materials (wood, block, metal, bottomless); missing internal components
Unk - Unknown or not applicable – Unable to view tank due to flooded conditions or lack of ability to view all or a portion of the tank

ET – (Enhanced Treatment)

MF - Media filter such as fabric or peat
ATU - Aerobic treatment unit
SF - Sand filter (prior to final dispersal)

Dispersal Type

BSF - Bottomless sand filter
CP - Cesspool
DF - Drainfield / leachfield
Drp - Drip
Mnd - Mound
PD - Pressure distribution
SP - Seepage pit
Unk - Unknown

Dispersal Condition

A - No sign of surfacing effluent, excessive hydrophilic vegetation, damage, erosion, a Hydraulic Load Test (HLT) of Satisfactory, Good or Excellent (S, G or E)
U - Any of the above factors or an HLT of Marginal, Poor or Failing (M, P or F)
Unk - Unknown or NA – Unable to test due to flooded tank, failed pump, leaking tank and / or leaking pressure transmission line

HLT – (Hydraulic Load Test)*

E - Excellent
G - Good
S - Satisfactory
M - Marginal
P - Poor
F - Failed
NA - Unable to test due to flooded tank, pump failure, lack of tank access, tank or line leaks

*See HLT testing protocol in Marin Environmental Health Policy *Memorandum #1*

Note:

In the spreadsheets seen below, I attempted to follow the format established by Kit Rosefield as much as possible to avoid any confusion. The only notable difference was the last column. Kit noted where possible when corrections had been made or were planned. I used that column for general comments.

Inspection Spreadsheets – Kit Rosefield – 1/26/04 to 1/31/06

Date	Vicinity	Proximity to Waterway		Type of Waterway	Septic Tank		ET	Dispersal		HLT	Corrections Made?	
		Tank	Dispersal	Type	Type	Cond.	Type	Type	Cond.	Rated	Y/N	Determination
1/26/04	Novato	35ft.	15ft.	Tidal slough	Pla.	U	-	DF	-	NA		
2/6/04	Novato	135ft.	102ft.	Perennial	Rdw.	U	-	DF	U	NA	Y	EHS permit # 04-05
2/6/04	Novato	120ft	80ft.	Estuary	Con.	A	SF	PD	A	G		
2/19/04	Woodacre	54ft.	76ft.	Perennial	Con.	A	-	MD	A	G		
3/10/04	Woodacre	50ft.	35ft.	Perennial	Con.	A	-	PD	A	G		
3/10/04	Woodacre	83ft.	115ft.	Perennial	Con.	A	-	MD	A	G		
3/17/04	Marshal	6ft.	6ft.	Bay	Con.	U	-	DF	A	G	Y	Pumped, repaired, risers installed
3/18/04	Lagunitas	124ft.	94ft.	Perennial	Rdw.	U	-	DF	U	F	Y	Soliciting designers
3/18/04	Woodacre	53ft.	10ft.	Perennial	Rdw.	U	-	DF	A	G	N	No action, yet
4/2/04	Inverness	71ft.	80ft.	Perennial	Con.	A	-	DF	A	S		
4/2/04	Inverness	82ft.	112ft.	Perennial	Con.	A	-	DF	U	F	N	No action, yet
4/13/04	Novato	95fr.	70fr.	Intermittent	Fbg.	U	-	DF	A	G	Y	New tank to be installed
4/21/04	Petaluma	130ft.	110ft.	Intermittent	Rdw.	U	-	DF	U	NA	Y	EHS permit #04-P-20
4/22/04	Point Reyes	65fr.	55ft.	Ephemeral	Con.	A	-	DF	A	G		
4/23/04	Woodacre	130fr.	145ft.	Perennial	Fbg.	A	-	PD	A	G		
4/25/04	Forest Knolls	40fr.	20ft.	Perennial	Con.	A	-	DF	A	G		
4/28/04	Novato	60fr.	70ft.	Intermittent	Con.	A	-	DF	U	F	Y	Repair made to diversion valve
4/28/04	Point Reyes	75fr.	75ft.	Ephemeral	Con.	U	-	DF	U	F	N	No action, yet
4/29/04	Forest Knolls	110ft.	98ft.	Perennial	Fbg.	U	-	LF	U	F	N	Dual LF, ½ failed, soliciting des.
5/5/04	Woodacre	35ft.	20ft,	Intermittent	Con.	A	-	DF	A	S		
5/5/04	Woodacre	65ft.	35ft.	Perennial	Con.	A	-	DF	A	G		
5/12/03	Lagunitas	25ft.	10ft.	Ephemeral	Con.	A	SF	PD	A	G		
5/12/04	Forest Knolls	67ft,	55ft.	Perennial	Con.	A	SF	PD	A	G		
6/3/04	Forest Knolls	33fr.	21ft.	Perennial	Rdw.	U	-	DF	A	G		
6/7/04	San Geronimo	130ft.	90ft.	Ephemeral	Con.	U	-	DF	A	G	Y	Inlet and tank crack repaired
6/8/04	Pt. Reyes Sta.	120ft.	80ft.	Ephemeral	Rdw.	U	-	DF	A	M	N	Soliciting designers
6/14/04	Petaluma	35ft.	35ft.	Ephemeral	Con.	A	-	DF	A	G		
6/15/04	Lagunitas	85ft.	95ft.	Ephemeral	Con.	A	-	DF	A	G		
6/28/04	Pt Reyes Sta.	25ft.	35ft.	Ephemeral	Con.	A	-	BSF	A	NA		
6/28/04	Pt. Reyes Sta.	75ft.	85ft.	Ephemeral	Con.	A	-	SFT	A	NA		

6/28/04	Pt. Reyes Sta.	135ft.	120ft.	Ephemeral	Con.	A	-	PD	A	NA		
7/1/04	Woodacre	150ft.	130ft.	Ephemeral	Con.	A	-	DF	U	NA		
7/24/04	Bolinas	110ft.	85fr,	Intermittent	Con.	A	-	DF	A	G		
7/24/04	Bolinas	>100ft.	>100ft.	-	Con.	U	-	DF	U	NA	Y	Repairs scheduled
8/30/04	Bolinas	90ft.	95ft.	Intermittent	FG	U	-	DF	A	NA		
8/30/04	Bolinas	90ft.	115ft.	Intermittent	FG	A	-	DF	U	NA	Y	Repairs scheduled
9/2/04	Bolinas	133fr.	73fr.	Ephemeral	FG	A	-	PD	A	NA		
9//2/04	Lagunitas	87ft.	87ft.	Ephemeral	Con.	A	-	DF	A	G		
9/8/04	Lagunitas	90ft.	75ft.	Ephemeral	FG	U	-	DF	A	NA	Y	Pricing tank replacement
9/30/04	Bolinas	25ft.	20ft.	Ephemeral	Con.	A	-	DF	U	NA	Y	Researching ET options
1/10/05	Inverness	20ft.	20ft.	Embayment	Block	U	-	SP	U	NA	Y	Hiring consultant
1/11/05	Forest Knolls	40ft.	15ft.	Perennial	Con.	A	-	DF	A	G		
1/11/05	Forest Knolls	45ft.	20ft.	Perennial	Rdw.	U	-	DF	A	NA	Y	Pricing tank replacement
1/14/05	Inverness	50ft.	80ft.	Ephemeral	FG	A	MF	DD	A	NA		
1/14/05	Inverness	15ft.	20ft.	Embayment	Con.	A	MF	PD	A	NA		
1/18/05	Forest Knolls	20ft.	30ft.	Perennial	Con.	A	MF	PD	A	NA		
1/27/05	San Geronimo	60ft.	95ft.	Ephemeral	Con.	A	-	PD	A	NA		
1/16/05	Forest Knolls	105ft.	95ft.	Ephemeral	Block.	U	-	DF	U	U	Y	Considering options
2/23/05	Woodacre	30ft.	20ft	Intermittent	Con.	U	ATU	DF	U	NA	Y	Hiring consultant
3/17/05	Forest Knolls	75ft.	120ft	Perennial	Con.	A	SF	PD	U	NA	Y	System under repair
3/29/05	Inverness Park	30ft.	20ft.	Intermittent	Con.	A	-	DF	A	G		
3/29/05	Inverness Park	130ft.	110ft.	Intermittent	Con.	A	-	DF	A	E		
3/30/05	Woodacre	30ft.	10ft.	Intermittent	Con.	NA	-	DF	U	NA	Y	High groundwater – drainage issue
3/30/05	San Geronimo	15ft.	60ft.	Intermittent	Con.	A	-	DF	A	E		
3/30/05	Forest Knolls	50ft.	50ft.	Ephemeral	Rdw.	U	-	CP	U	NA	?	Owner agrees replacement needed
3/30/05	Forest Knolls	35ft.	75ft.	Perennial	Con.	A	SF	DF	A	NA		
4/29/05	Woodacre	40ft.	30ft.	Ephemeral	Con.	A	SF	PD	A	NA		
5/3/05	Lagunitas	45ft.	60 ft.	Ephemeral	Con.	A	-	DF	A	G		
5/3/05	Woodacre	75ft.	50ft.	Ephemeral	FG	A	-	SP	U	F	Y	Repair in process.
5/5/05	Lagunitas	30ft.	45ft.	Ephemeral	Con.	A	-	DF	A	G		
5/5/05	Woodacre	85ft.	60ft.	Ephemeral	Con.	U	-	DF	U	F		Recommendations made.
5/16/05	Inverness	60ft.	50ft.	Ephemeral	Con.	A	-	DF	A	G		
5/18/05	Woodacre	65ft.	60ft.	Intermittent	Con.	A	-	DF	U	NA	Y	Repairs scheduled according to owner.
6/1/05	Forest Knolls	110ft	60ft	Ephemeral	Con	A	-	DF	A	G		

6/1/05	Woodacre	35ft.	20ft.	Perennial	Con.	A	-	DF	A	S		
6/7/05	Woodacre	65ft.	15ft.	Ephemeral	Con.	U	-	DF	A	G	Y	Inquiring about tank replacement
6/8/05	Forest Knolls	55ft.	75ft.	Ephemeral	Con.	A	-	PD	U	P	Y	Scheduled system service
6/9/05	San Geronimo	15ft.	35ft.	Perennial	Con.	A	-	DF	A	G		
6/9/05	Nicasio	50ft.	?	Ephemeral	Con.	A	-	?	U	F	Y	Selecting Designer
6/14/05	Lagunitas	150ft.	175ft.	Ephemeral	Con.	A	-	DF	A	G		
6/21/05	Lagunitas	75ft.	40ft.	Perennial	FG	A	-	DF	A	G		
6/22/05	Inverness	120ft.	130ft.	Ephemeral	Con.	A	-	PG	F	NA	Y	Electrical problem- repairs to be scheduled
6/22/05	Inverness	20ft.	150ft.	Ephemeral	Con.	A	-	PG	A	G		
6/24/05	Forest Knolls	25ft.	25ft.	Perennial	FG	A	-	DF	A	G		
6/24/05	Forest Knolls	35ft.	30ft.	Ephemeral	Con.	A	SF	PD	A	G		
7/12/05	Inverness	100ft. +	100ft. +	N/A	Con.	A	-	DF	A	G		
7/12/05	Inverness	75ft.	95ft.	Intermittent	FG	U	-	DF	A	G	Y	Client to have inlet fitting installed.
7/12/05	Inverness	100ft. +	100ft. +	N/A	Con.	N/A	-	DF	U	N/A	Y	Tank backed up, owner to contact contractor.
7/13/05	San Geronimo	75ft.	75ft.	Perennial	Rdw.	U	-	DF	U	N/A		Tank backed up, owner exploring options.
7/13/05	Forest Knolls	60ft.	30ft.	Intermittent	Con.	A	-	PD	A	G		
7/18/05	Inverness	60ft.	30ft.	Ephemeral	FG	U	-	DF	A	G		Owner contacting contractors for repair.
7/18/05	Inverness	75ft.	65ft.	Ephemeral	Rdw	U	-	DF	N/A	N/A		Tank deterioration disallowed HLT. Owner exploring tank replacement.
7/20/05	Inverness	100ft. +	100ft. +	N/A	Con	U	-	DF	N/A	N/A		Cracked tank not water tight. Owner exploring options.
7/21/05	Woodacre	55ft.	65ft.	Perennial	Con	A	-	DF	A	G		
8/18/05	Woodacre	55ft.	25ft.	Ephemeral	Block	U	-	DF	A	G		
8/24/05	Pt. Reyes	100ft+	100ft +	N/A	Con	A	-	DF	A	G		
8/24/05	Inverness	65ft	35ft	Perennial	Con	A	-	DF	A	M		
8/25/05	Lagunitas	70ft.	70ft.	Perennial	FG	A	-	DF	A	G		
8/29/05	Lagunitas	30ft.	N/A	Intermittent	CP	U	-	CP	U	N/A		Owner evaluating options.
8/29/05	Woodacre	30ft.	20ft.	Perennial	FG	A	-	DF	A	M		
8/31/05	San Geronimo	25ft.	25ft.	Intermittent	FG	A	-	DF	A	G		
9/20/05	San Geronimo	85ft.	65ft.	Perennial	Con	A	-	DF	A	G		
9/20/05	San Geronimo	120ft.	95ft.	Perennial	FG	U	-	DF	A	G		Owner considering tank

												replacement
9/23/05	Lagunitas	40ft.	25ft.	Perennial	FG	U	-	DF	U	N/A		Owner seeking consultant.
1/9/06	Nicasio	135ft.	100ft.	Perennial	Rdw	U	-	DF	NA	NA		Contacting contractors for tan replacement
1/31/06	Marshall	150r5.	110ft.	Bay	Con.	NA	-	DF	U	NA		Seeking designer
1/31/06	Forest Knolls	60ft.	25ft.	Perennial	Con.	U	--	DF	NA	NA		Contacting contractors for tank replacement
1/31/06	Forest Knolls	30ft.	15ft.	Perennial	Rdw.	U	-	DF	U	F		Seeking designer

<u>Inspection Spreadsheets – Mike Treinen – 12/3/07 to 3/22/08</u>

Date	Vicinity	Proximity To Waterway		Type of Waterway	Septic Tank		ET	Dispersal System		HLT	Comments re: the System Constraints
		Septic Tank	Dispersal System	Type	Type	Cond	Type	Type	Cond.	Rating	
12/3/07	Woodacre	50	20	Intermittent	FG	Unk.	-	SP/DF	U	n/a	Tank/Risers flooded
“	“	20	10	"		A	-	DF	U	F	GW & Drainage issues
1/7/08	“	60	60	“	Rdw	U	-	DF	U	n/a	Tank flooded, GW, Graywater
“	“	60	60	“		Unk	-	DF	U	n/a	Tank flooded, GW
“	“	60	60	“	FG	A	-	SP	A	S/M	Graywater, GW(?)
1/11/08	“	100	100+	Perennial	Con	A	-	DF	A	E	DF in Driveway
“	“	70	50	“	“	A	-	SP	U	P	-
1/16/08	“	75	75	Intermittent	“	Unk	-	DF	U	n/a	Tank Flooded, GW
“	“	75	75	“	“	A	-	Unk	A	E	-
1/23/08	“	100	60	“	“	A	-	DF	A	E	-
“	“	100	75	“	“	Unk	-	SPs	U	n/a	GW into tank – pumped into SPs
“	“	75	60	“	“	Unk	-	SP	U	n/a	GW @ 4” – covering tank, Graywater
2/1/08	“	100	75	“	“	Unk	-	DF	U	n/a	Tank flooded
“	“	75	20	“	“	A	MF	MD	A	E	Pump very slow
“	“	25	75	Perennial	“	A	-	DF	A	S/M	-
2/8/08	“	100	20	Intermittent	“	A	MF	MD	A	E	GW @ 12”
“	“	100	100	“	FG	A	-	DF	U	n/a	GW @ 6-8”, DF not working
“	“	40	80	Perennial	Con	Unk	-	PD	n/a	n/a	Pump not working
2/11/08	Pt. Reyes	40	90	Embayment	Con	A	-	MD	A	E	-
“	“	50	100	“	“	A	-	MD	A	E	Apparent gravel bed clogging

“	Inverness	100	80	“	FG	A	-	DF	A	E	Dual system – newer
2/19/08	Woodacre	90	60	Perennial	Con	A	-	DF	A	E	Graywater
“	“	85	65	Intermittent	Rdw	U	-	SP/DF	U	n/a	GW, SP not working
“	“	40	20	“	Con	A	-	DF	U	P	GW
“	“	20	30	“	“	Unk	-	SP	A	E	Deep outlet not uncovered

Date	**Vicinity**	**Proximity To Waterway**		**Type of Waterway**	**Septic Tank**		**ET**	**Dispersal System**		**HLT**	**Comments re: the System Constraints**
		Septic Tank	**Dispersal System**	**Type**	**Type**	**Cond**	**Type**	**Type**	**Cond.**	**Rating**	
2/27/08	Woodacre	30	40	Perennial	Con	Unk	-	DF	Unk	n/a	Pump tank flooded
“	“	100	100	Intermittent		U	-	DF	A	S/M	-
“	“	80	50	“	“	U	-	Unk	U	n/a	Tank flooded
3/14/08	“	50	50	“		U	-	Unk	U	n/a	Tank flooded, mosquito breeding
“	Forest Knolls	100	75	“	Con	A	-	DF	U	n/a	DF failing
“	Lagunitas	100	100	Perennial	“	A	-	DF	A	E	Tank leaking, pump in tank to DF
“	Woodacre	50	10	Intermittent	“	A	-	DF	A	E	Pump tank not watertight
3/17/08	“	100+	100+	Perennial	“	A	-	BSF	A	E	Newer bottomless sand filter
“	“	20	30	Intermittent	“	Unk	-	DF	U	n/a	Tank flooded
“	“	100+	100+	Perennial	FG	A	-	DF	Unk	n/a	Pump not working
“	“	20	30	“	Con	A	-	DF	U	P	Blockage or DF not working
3/19/08	“	100	80-100	“	“	A	-	DF	A	E	Evidence of High GW
“	“	100	80-100	“	“	A	-	DF	A	S	-
“	“	75	50-75	Ephemeral	“	U	-	Unk	Unk	n/a	Tank leaking, graywater
3/21/08	“	100	100	Perennial	FG	U	-	DF	Unk	n/a	Tank leaking & pump pipe leak
“	“	100	90	“	Rdw	U	-	SP	A	Unk	Leaks around outlet pipe
“	“	80	80	“	“	U	-	DF	Unk	n/a	Tank had not been uncovered
“	“	60	100+	“	FG	Unk	-	DF	Unk	n/a	Pump not working; both tanks full
“	“	35	45	Intermittent	Con	A	-	DF	U	F	DF under driveway
“	“	75	85	“	“	A	-	DF	A	S/M	Evidence of high GW
3/22	“	100+	100+	“	“	A	-	DF	U	N/A	GW, high water level in tank, Dual
“	“	90	80	“	“	A	-	SP	A	E	-
“	“	100+	100+	Perennial	“	U	-	DF?	Unk	n/a	Bottomless tank

Blank Sheet

2010 Questa Field Reviews

Field Review Notes for West Subarea
(Woodacre Creek Corridor and SW of Railroad Ave)

System ID	System Address	Site Conditions Summary					Recommended System Upgrade	Creek Setback Compliance with Upgrade		Other Variance Issues
		Bldg. Size	Slopes	Effective Soil Depth	Depth to GW	Drainage Features		with 100% System	with 200% System	
1	Undisclosed	3BR + cottage	<4%, flat	60"+	none to 60"	(E) modern dual low flow mound close to creek (16-23'), 5' elevation drop from S.G. Valley Dr to property	None (Class 2 system)	N	N	None (Class 2 system)
2	Undisclosed	2 BR	35-50%	72"	none to 6'	Seasonal creek is adjacent to existing ST and approx 25' laterally to drainfield. It drains to roadside ditch near DS PL.	Generally not suitable for OWTS, poss segmented raised drip	N	N	Setback variances req'd
3	Undisclosed	2BR	varies, 20%	18"	none to 18"	ST and LF are adjacent to Woodacre Creek. Vertical creek banks are 10-15' high.	Gnerally not suitable for OWTS, poss segmented raised drip	N	N	Setback variances req'd
4	Undisclosed	3BR	flat, <2%	54"+	62" (3/01)	Roadside ditches on Park and Rairoad	None (Class 2 system)	Y	Y	None (Class 2 system)
5	Undisclosed	2BR	approx 50% some small benched areas	48-52"	none to 72"	ST, Pump and PD trenches are adjacent to Woodacre Creek (trenches by 25'-wide flood plane), deep soils are 40' from opposite-side street drainage that collects upslope runoff	Drip w/ curtain drain and setback variances	N	N	Setback variances req'd
6	Undisclosed	2BR	flat, <2%	6" over bedrock	none to 6"	House extends past top of bank on flood plain of Woodacre Creek. Top of bank is 70-75' from opposite PL.	Raised drip w/ setback variance	N	N	Setbacks to Bldgs, pavement and PL's
7	Undisclosed	4BR	flat, <2%	unknown	unknown	Approx 100' to Woodacre Creek (located on neighboring property.)	Drip or raised drip w/ setback variances	N	N	Setback variances req'd
8	Undisclosed	4BR	flat, <2%	6-8" soil over RR bedding & serpentine	none to 8"	1-2' elevation drop (east to west) at side property lines, small elevation drop to streetside ditch	Raised drip w/ setback variance	N	N	Setback variances req'd
9	Undisclosed	1BR	flat, <2%	12"	none to 12"	House partially hangs over creek and sewer line crosses bridge to deep-buried ST and PC. Woodacre Creek is 55-60' from opposite property line. Almost-vertical creek banks.	Shallow drip, possible mound, w/ setback variance	N	N	No development on adjacent lot
10	Undisclosed	1BR	flat, <2%	6' w/ probe	none to 6'	Woodacre Creek is 85-110' from opposite PL. There is a flood plain below top of bank that extends the setback to water approx 40'	Std PD or Drip	N	N	Setbacks to Creek, Bldgs, PL's
11	Undisclosed	unknown	32-35%	unknown	unknown	7' cutbank retaining wall w/ backdrain, 28' setback to LF was maintained	None (apparent Class 1 system)	Y	Y	None (apparent Class 1 system)
12	Undisclosed	26'x44', 2 stories	2 -4%	5' w/ probe	none to 60"	Confluence of two tributaries on two sides of property	Drip or raised drip w/ setback variances	N	N	Creek on two sides w/ no suitable setbacks, property mostly covered w/ pavement and bldgs
13	Undisclosed	1400 ft2	flat, <2%	28"	seeps at 16" and 24"	street ditches along N & W PL's	Drip	Y	Y	Setbacks to Bldgs, pavement and PL's

Field Review Notes for Central Subarea
(NW of Railroad Ave to Central Ave & Park St)

System ID	System Address	Site Conditions Summary					Recommended System Upgrade	Creek Setback Compliance with Upgrade		Other Variance Issues
		Bldg. Size	Slopes	Effecitive Soil Depth	Depth to GW	Drainage Features		with 100% System	with 200% System	
14	Undisclosed	Post office, 200gpd	flat, <2%	18"	none to 32"	No absorbtion area between mound and road (paved sidewalk). Effluent spill would flow to roadside ditch that starts at adjacent property. Also, a tributary is located across S.G. Valley Drive from N side PL.	None (Class 1 system) Reserve mound not built.	Y	N	Almost all property occupied by bldgs or pavement
15	Undisclosed	2BR	flat, <2%	26"	seeps @ 16" (near LF) and 24"(front yard)	Paved curbside in front of property	Raised drip w/setback variances	Y	Y	Setback variances req'd
16	Undisclosed	2+2BR?	flat, <2%	24"	none to 24"	Hand-dug drainage trenches from back corners of lot to street	Generally not suitable for OWTS, possible raised drip w/setback variances	Y	Y	Setback variances req'd
17	Undisclosed	2BR, but has daycare with 12+ kids	flat, <2%	18"	18" near trenches, 8" in (irrigated) front yard	Sump in back corner of lot (near trenches) carries GW to street	Generally not suitable for OWTS, possible raised drip w/setback variances, including exist. landscaping areas	Y	Y	Almost all property occupied by bldgs, pavement, compacted or filled areas
18	Undisclosed	3BR	flat, <2%	14"	none to 14"	Lot adjacent to compacted horse area	None (Class 1 system)	Y	Y	Class 1 system, w/ seasonal high GW
19	Undisclosed	3BR	2-3%	28"	none to 36"	Berm along back PL, shallow V-ditch 5' from east PL outlets to DI on Railroad Ave	Raised drip field	Y	Y	(E) pool on adjacent properties to the east and west
20	Undisclosed	2BR	flat to 2%	54" (dense)	54"	roadside ditch on Central	Dip or raised drip; not enough room for mound w/out setback variances	Y	Y	Bldg and PL setback variances required
21	Undisclosed	1500 ft2 plus conditioned garage (3BR?)	2-3%	18"	moist no GW to 46"	Low area in back yards of adjacent lots (same owner) side-yard french drains to Railroad Ave.	100% (but not 200%) mound for main lot, or drip. Existing PD system on 2nd lot is used in winter	Y	Y	Main lot back yard setbacks possible, but not in front. 2nd lot mostly undeveloped
22	Undisclosed	3BR	flat, <2%	20"	28" seeps	Back PL is low elevation. Side PL concrete ditches from back corners to Railroad ave	Generally not suitable for OWTS, possibly raised drip w/setback variances.	Y	Y	Bldg, pavement and PL setback variances required

Field Notes for Central Subarea (continued)

System ID	System Address	Site Conditions Summary					Recommended System Upgrade	Creek Setback Compliance with Upgrade		Other Variance Issues
		Bldg. Size	Slopes	Effecitive Soil Depth	Depth to GW	Drainage Features		with 100% System	with 200% System	
23	Undisclosed	3BR	flat, <2%	8"	8"	Sub drain down east PL to Railroad	Generally not suitable for OWTS, possibley segmented raised drip w/setback variances in non-paved areas	Y	Y	Small areas in front and side yards will require setbacks variances to bldg, pavement and PLs
24	Undisclosed	2BR	3%	18"	seep at 15" rose to 13" (in vicinity of LF)	House rearyard foundation perimeter drains to DI.	Raised drip with setback variances	Y	Y	Setback to foundation drainage variance req'd. There is available area in front yard but would req PL, bldg and pavement setback variances.
25	Undisclosed	3BR	flat, <2%	36"	moist at 30"	Roadside ditches on both sides of Carson; far side was flowing, lot-side was not	Drip or raised drip with setback variances	Y	Y	Setback variances to PLs, bldg, pool and pavement req'd.

Field Review Notes for East Subaea

(Including Grant St, Taylor Ave, and East End Central Ave)

System ID	System Address	Site Conditions Summary					Recommended System Upgrade	Creek Setback Compliance with Upgrade		Other Variance Issues
		Bldg. Size	Slopes	Effective Soil Depth	Depth to GW	Drainage Features		with 100% System	with 200% System	
26	Undisclosed	2BR	2-20%	36"	30"	Curtain drain at top of slope, appears to outlet above 172-061-09 (Corridor 2)	Mound is ideal	Y	Y	2' cut bank at downslope PL. There is room for other setbacks.
27	Undisclosed	2800 ft2	mostly flat, <2%. 4-35% in small side yard	48"	40"	2' cut bank at downslope PL (very close to DS bldg fdn.)	Segmented drip w/surface drainage & curtain drain	Y	Y	Setback variances req'd
28	Undisclosed	2BR	4%	48"	40"	18" flowing culvert runs under Taylor and oulets to NW corner of properly before disappearing. Possible buried DI that collects flow and carries along west PL.	Drip w/ setback variances and drainage control	Y	Y	Setback variances req'd
29	Undisclosed	3BR	5%	30"	none to 60"	Concrete lined ditch collects street runoof and diverts to SE neighbor's (172-064-08) sump	Raised drip w/ setback variances and drainage control	Y	Y	2' cut bank at downslope PL. There is room for other setbacks.
30	Undisclosed	2BR	3-4%	30"	28"	House foundation subdrain was flowing 5 gpm, and daylights to SW back yard. Downslope parcel 172-064-08 has a DI that collects this flow. Also many cut banks, including downslope PL (2')	Raised drip w/ setback variances and drainage control	Y	Y	Setback variances req'd
31	Undisclosed	2BR	30-70%	6"	none to 6"	Two upslope V-ditches that divert surface flow to street ditch	Extremely shallow soils would require engineered , raised drip beds, including use of extensive landscaping area	Y	Y	Setback variances req'd
32	Undisclosed	3BR	3%	36"	36" in sloping back yard, 42" in front flat	Ct bank at upslope PL is adjacent to 5' trenches that act as curtain drain (GW intrusion backs up to ST)	Drip or raised-drip w/ setback varieances and GW/drainage control	Y	Y	Setback variances req'd
33	Undisclosed	3BR	8-9%	42"	minor seeps to 42", major seep at 60"	House foundation leaks during winter per owner. Wall drains were noted along foundation.	Rom for a mound	Y	Y	PL setback variance req'd but bldg and pavement setbacks can be maintained

Appendix C

Woodacre Wastewater Questionnaire Survey Results

Civil, Environmental & Water Resources

QUESTA ENGINEERING CORP.

May 17, 2023

Subject: Woodacre Wastewater Feasibility Study
Voluntary and Anonymous Wastewater Survey Questionnaire

Dear Property Owner:

Questa Engineering Corporation (Questa) has been retained by the County of Marin to conduct a community wastewater feasibility study for the lower sections of Woodacre, centered around the "Flats". The purpose of the study is to evaluate existing conditions and practices, wastewater treatment and disposal needs, and potential long-term wastewater management alternatives, including onsite septic system upgrades/maintenance, community sewerage, and water recycling.

An important part of the study is to obtain as much information as possible about the type, age and functioning of existing septic systems. This involves reviewing information in County files (already conducted) and also collecting information directly from property owners about their knowledge, concerns and views on potential long-term wastewater management options for the community. To accomplish this we have prepared the attached wastewater survey questionnaire, which is being distributed to all property owners in the tentative service area (approximately 250 developed parcels). Participation in the survey is **voluntary**, but we have made the questionnaire **anonymous** to encourage as much participation as possible. We would appreciate you completing the form to the best of your knowledge and returning it to Questa, using the stamped, addressed envelope provided. Alternatively, you may return it by email if you choose. **We are requesting that you return the completed forms by Friday June 9, 2023, if possible**. A separate abbreviated questionnaire survey will be made available on the Marin County Environmental Health Services website to obtain input from property owners in other parts of Woodacre and neighboring areas of San Geronimo Valley.

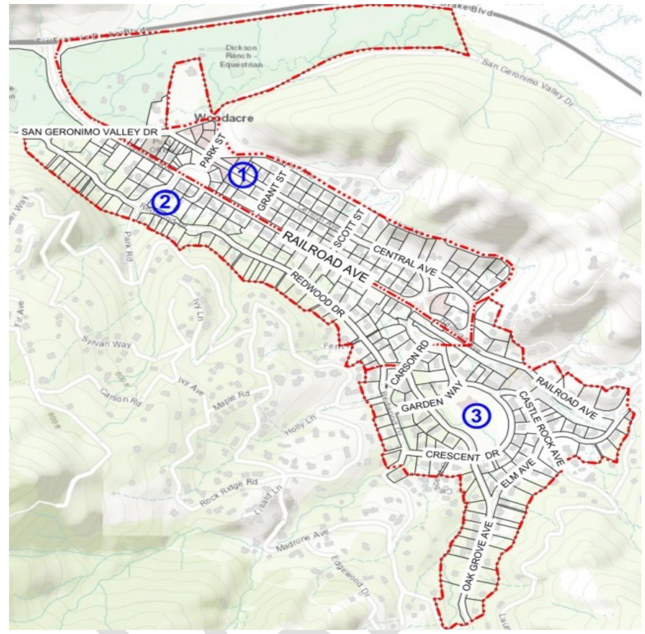
Please understand that the purpose of the survey is to gather information useful for assessing community needs as a whole, and not for site specific property evaluation. You will note that the questionnaire does not ask for the owner's name or property address, only the general area in Woodacre where the property is located: (1) east of Railroad, (2) west of Railroad, and (3) south of Carson/Central. Neither the completed survey forms nor any site specific information a property owner may wish to offer will be provided to the County or others for any type of enforcement or abatement action. The survey forms will be retained by Questa and reviewed solely for the purpose of the community wastewater feasibility study. The results will be compiled, summarized and presented in the project report and community meetings.

If you have any questions regarding this questionnaire or the study in general, please contact the undersigned by email. Your cooperation and assistance with this survey will be greatly appreciated.

Sincerely,

Norman N. Hantzsche, PE
Principal/Managing Engineer
nhantzsche@questaec.com

Woodacre Community Wastewater Questionnaire
May 2023



GENERAL

1. General property location, circle per map: **1 2 3**
2. Size of home (# of bedrooms)
   - Primary residence: ________
   - Secondary Dwelling/ADU: _______
3. Total number of full-time occupants: _______
4. Average winter water use: ________ gallons per day
   (From water bill, Nov-April, if available)

SEPTIC TANK

5. Septic tank construction and age (to the best of your knowledge):
   - Material: concrete ______; fiberglass/plastic _______; redwood ______; unsure ______
   - Approx age of tank: <20 yrs ______; 20-40 yrs_______; >40 yrs_______; unsure ______
   - Size/capacity of tank: _________ gallons; unsure ________
   - Does the tank have access risers at/near grade? yes ______; no________; unsure ______

6. Septic tank location (check all that apply):
   - Front of house ______; side yard ______; back of house ________; unsure ________
   - Yard area ______; Under deck/structure ______; Traffic/paved area ______; unsure _______

7. Maintenance and operational issues (to the best of your knowledge):
   - Pump-out frequency: more than 1/yr_____; every 1 yr ____; 2-5 yrs____; 5-10 yrs____; >10 yrs____
   - Any recurring incidents of (check all that apply):
     - plumbing backups/sewage surfacing ______; root intrusion, pipe blockage________
     - structural damage/decay_________; nuisance odors _________
     - other:____

LEACHFIELD

8. Leachfield design/construction and age (to the best of your knowledge):
   - Type: trench _____; mound _____; drip field ______; seepage pit______; raised bed______; unsure ______
   - Any inspection pipes in leachfield to check trench water levels? yes _____; no _____; unsure ______
   - Approx age of current leachfield: <20 yrs _____; 20-40 yrs______; >40 yrs _____; unsure ______
   - Single Leachfield _______ or Dual Leachfield w/valve_________; unsure ________
   - Do you have a designated "reserve" leachfield area: yes _____; no _____; unsure ________
   - Do you have a pump system: pump to gravity trenches: ______; pressure distribution: _____ unsure ______

9. Leachfield location (check all that apply):
   - Front of house _____; side yard ______; back of house _____; off-site easement _______; unsure ______
   - Yard area: ______; Under deck/structure: ________; Traffic/paved area ______; unsure ______
10. Leachfield maintenance and operational issues:

- Any recurring incidents of (check all that apply):
  (a) sewage surfacing, down-slope hillside seepage ______; (b) root intrusion, blockage______
  (c) settlement, erosion ______; (d) nuisance odors ______; (e) Other ___________________________
- Any special circumstances/notes: ____

11. Special measures taken to improve leachfield functioning, such as:
    (a) french drain/curtain drain _______; (b) sump pump _______;
    (c) drainage diversion ditches or piping _______; (d) other ____

ALTERNATIVE SYSTEM

12. Do you have an alternative treatment system such as: Sand filter____; AdvanTex______; Peat filter______; Aerobic Unit ______; Other ____

13. Do you have a County operating permit with monitoring and reporting? yes ______; no______ unsure_____

GRAYWATER

14. How is your clothes washer and other graywater disposed of?

	Clothes washer	Other (bath, shower, hand sinks)
• Into septic tank	_____	_____
• Directly to leachfield	_____	_____
• To landscape/garden	_____	_____
• Onto ground surface/drainage	_____	_____

SITE CONDITIONS

15. To the best of your knowledge and understanding, rate how much you believe each of the following site conditions presents a constraint/problem for proper septic system operation on your property.

Site Condition	Constraint Level			
	N/A	Low	Med	High
Shallow winter water table/soil saturation				
Poor soil permeability				
Poor surface water drainage				
Shallow bedrock/clay layer				
Steep slope				
Insufficient area				
Inadequate setbacks to drainages/streams				
Other? ___________________________________				

16. Has your septic system/property been inspected and evaluated by a contractor or professional to determine its functioning status and/or options for repair, expansion or replacement?

- yes___; no____
- Summarize any results you would like to share: ____
  ____

Issues and Levels of Concern

Indicate your level of concern about the following:

Issue	Level of Concern Low		Medium		High
	1	2	3	4	5
1. Condition, age, functioning of your existing septic system					
Operation in normal rainfall years					
Operation in high rainfall years					
Operation in the summer					
For possible selling or refinancing					
For possible house or property improvements					
Other? ___________________________________					
2. Code compliance, non-conforming, or non-documented status of your existing septic system					
For possible selling or refinancing					
For possible house or property improvements					
Other? ___________________________________					
3. General interference of your existing septic system with use and enjoyment of your property					
For current uses					
For possible house or property improvements					
4. Public health and water quality impacts from yours and/or other septic systems in the community					
Contaminated water in residential yards					
Contaminated water in local drainages					
Contaminated water flow between properties					
Downstream water quality impacts in Woodacre, San Geronimo and Lagunitas Creeks					
Odors or other nuisance conditions					
Public health issues from observed rainy season septic system problems at neighboring properties					
Other? ____________________________________					

17. Other comments regarding your concerns or opinions about existing septic system practices and environmental conditions in the Woodacre community: ____
____
____

18. How educated or informed do you consider yourself regarding:
    (a) septic systems in general: Poor____; Ok _____; Good ____; Very Good _____
    (b) Woodacre septic system issues: Poor____; Ok _____; Good ____; Very Good _____

19. List any suggestions on additional septic system-wastewater education that you would like to see provided or facilitated by the County:
____
____
____
____

Wastewater Management Interest and Preferences. Indicate below your ranked preference (1st through 6th) for the six (a through f) Wastewater Management Alternatives that are being considered for Woodacre.

Wastewater Management Alternative	Ranked Preference (fill-in circle to indicate preference)						
	Parcels Served	1st	2nd	3rd	4th	5th	6th
a) No Project – status quo	All	O	O	O	O	O	O
b) Onsite Management/Upgrade Program **-** oversight and financing program for upgrades to existing OWTS	All	O	O	O	O	O	O
c) Primary Treatment & Leachfield - STEP/STEG effluent collection system - year-round leachfield at Dickson Ridge	100 to 150	O	O	O	O	O	O
d) Secondary Treatment & Leachfield - STEP/STEG effluent collection system - secondary treatment at Dickson Ranch - year-round leachfield at Dickson Ridge	200 to 300	O	O	O	O	O	O
e) Secondary Treatment, Recycling & Leachfield - STEP/STEG effluent collection system - secondary treatment at Dickson Ranch - winter leachfield at Dickson Ridge - seasonal recycled water for pasture/open space irrigation & other secondary uses	200 to 300*	O	O	O	O	O	O
f) Tertiary Treatment, Recycling & Leachfield - STEP/STEG effluent collection system - tertiary treatment at Dickson Ranch - winter leachfield at Dickson Ridge - seasonal recycled water for landscape and pasture irrigation & other tertiary uses	200 to 300*	O	O	O	O	O	O

*may include connection from Spirit Rock Center to share in treatment facilities and irrigation recycling uses

Assumptions on Costs and Financing. Cost estimates have not yet been fully developed for specific project alternatives; however, the following can be assumed about how capital costs would be financed:

- **Status Quo** – cost of improvements would be private property owner responsibility.
- **Onsite Management/Upgrade Program** – low interest loans may be available to individuals for onsite system upgrades.
- **Community System Alternatives (c through f)** – community facilities would be financed with some level of grant assistance and low interest loans/bonds that would spread costs over a 30-year payback period; property assessments on tax bill (subject to 51% community approval) would likely be in the range of $1,500 to $2,000 per year, depending on the number of connections, project details and grants.

Proposed Service Area Boundaries. Provide input on the tentative service area boundary being considered for community facilities:

- _______Ok as proposed
- _______Reduce in size by eliminating ____
- _______Increase in size by adding ____

Other Comments. Feel free to attach any additional comments and suggestions.

Woodacre Wastewater Feasibility Study – Questionnaire Survey
Glossary of Terms

Onsite Wastewater Treatment System (OWTS): A system of pipes, tanks, trenches and other components used for the collection, treatment and subsurface dispersal of domestic wastewater at or near the building or buildings being served. It is commonly called a "septic system".

Septic Tank: A buried watertight tank that receives sewage from the house, that functions to separate solids from liquids, retains and digests organic matter and discharges the clarified effluent to a secondary treatment unit, directly to the disposal field, or to an effluent sewer system.

Graywater: Refers to wastewater from clothes washer, bathroom sinks, showers and bathtubs but not from kitchen sinks, dishwashers, toilets or waste from dirty diapers. Reuse of graywater can aid in water conservation and relieve stress on septic systems and is permitted under the California Plumbing Code.

Leachfield, Drainfield or Disposal Field: Commonly a system of rock-filled trenches or beds with distribution piping, usually about 3 to 8 feet deep, that receives sewage effluent from the septic tank (or advanced treatment system) and disperses the effluent into the soil by percolation. Variations include: pressure distribution, raised or mounded systems, gravel substitutes and subsurface drip dispersal lines.

Conventional Gravity Sewer: A sanitary sewer relying on a system of gradually sloping pipelines, along with lateral sewer connections, cleanouts and manholes, used to collect and convey raw sewage downhill to a treatment plant or pump station.

Effluent Sewer: A system of small diameter pipelines (e.g., 4-inch diameter) that collect and convey sewage effluent that has gone through septic tank treatment at individual properties before entering the collector pipes. The effluent from the each property is discharged either by gravity (STEG) or by a pump (STEP).

STEG: Stands for "Septic Tank Effluent Gravity" and consists of an individual septic tank, effluent filter, access risers and outlet piping that provides primary sewage treatment (settling and separation of solids) and gravity discharge of effluent to an effluent sewer collection system.

STEP: Stands for "Septic Tank Effluent Pump" and consists of an individual septic tank and effluent pumping unit which is located in the second chamber of the tank or in a separate tank. The effluent from the STEP unit is discharged by pumping to either a pressure or gravity effluent sewer system.

Primary Treatment: Primary treatment of wastewater provides for separation, screening and settling of sewage solids, such as occurs in a septic tank.

Secondary Treatment: Secondary treatment of wastewater makes use of oxygen for biodegradation of organic matter, commonly employing one of three methods: biofiltration (e.g., sand, gravel or other media filter), mechanical aeration, or oxidation pond.

Tertiary Treatment: Tertiary treatment of wastewater follows the secondary process and is commonly used either for: (a) removal of specific wastewater constituents (e.g., phosphorus, trace metals): or (b) microfiltration and disinfection to meet standards for water recycling.

Woodacre Wastewater Questionnaire Survey Results

Issues - Level of Concern - Zone 1 (%)

Issue	Level of Concern: Low 1	2	Medium 3	4	High 5	None
1. Condition, age, functioning of your existing septic system						
Operation in normal rainfall years	43	10	27	7	3	10
Operation in high rainfall years	30	7	10	10	37	7
Operation in the summer	60	20	7	3	0	10
For possible selling or refinancing	23	20	7	13	20	17
For possible house or property improvements	23	7	17	7	30	17
Other? ___________________________________						
2. Code compliance, non-conforming, or non-documented status of your existing septic system						
For possible selling or refinancing	33	7	17	3	27	13
For possible house or property improvements	33	3	17	0	33	13
Other? ___________________________________						
3. General interference of your existing septic system with use and enjoyment of your property						
For current uses	37	20	23	7	7	7
For possible house or property improvements	20	17	20	13	17	13
4. Public health and water quality impacts from yours and/or other septic systems in the community						
Contaminated water in residential yards	23	10	17	10	30	10
Contaminated water in local drainages	23	7	17	7	37	10
Contaminated water flow between properties	20	10	13	13	33	10
Downstream water quality impacts in Woodacre, San Geronimo and Lagunitas Creeks	17	7	10	10	47	10
Odors or other nuisance conditions	23	10	20	7	27	13
Public health issues from observed rainy season septic system problems at neighboring properties	30	0	7	13	37	13
Other? ___________________________________						

Issues and Levels of Concern - ZONE 2 (%)

Issue	Level of Concern Low	 	 Medium	 	 High	None
	1	2	3	4	5	
1. Condition, age, functioning of your existing septic system						
Operation in normal rainfall years	68	0	21	5	5	0
Operation in high rainfall years	42	16	21	5	16	0
Operation in the summer	74	16	5	5	0	0
For possible selling or refinancing	58	0	21	5	16	0
For possible house or property improvements	47	5	11	11	26	0
Other? ___________________________________						
2. Code compliance, non-conforming, or non-documented status of your existing septic system						
For possible selling or refinancing	58	0	11	0	26	5
For possible house or property improvements	53	0	16	0	26	5
Other? ___________________________________						
3. General interference of your existing septic system with use and enjoyment of your property						
For current uses	74	11	1	5	0	0
For possible house or property improvements	53	5	16	11	16	0
4. Public health and water quality impacts from yours and/or other septic systems in the community						
Contaminated water in residential yards	37	16	11	21	11	5
Contaminated water in local drainages	37	0	21	16	26	0
Contaminated water flow between properties	47	11	11	16	11	5
Downstream water quality impacts in Woodacre, San Geronimo and Lagunitas Creeks	26	16	11	16	32	0
Odors or other nuisance conditions	37	26	5	21	5	5
Public health issues from observed rainy season septic system problems at neighboring properties	42	0	16	21	21	0
Other? ____________________________________						

Issues and Levels of Concern - ZONE 3 (%)

Issue	Level of Concern Low 1	2	Medium 3	4	High 5	None
5. Condition, age, functioning of your existing septic system						
Operation in normal rainfall years	34	3	17	17	7	21
Operation in high rainfall years	28	3	14	14	21	21
Operation in the summer	38	10	17	3	7	24
For possible selling or refinancing	31	7	3	7	31	21
For possible house or property improvements	31	7	10	0	28	24
Other? ___________________________________						
6. Code compliance, non-conforming, or non-documented status of your existing septic system						
For possible selling or refinancing	31	7	10	0	28	24
For possible house or property improvements	28	3	17	0	21	31
Other? ___________________________________						
7. General interference of your existing septic system with use and enjoyment of your property						
For current uses	38	3	10	10	7	31
For possible house or property improvements	28	3	14	0	24	31
8. Public health and water quality impacts from yours and/or other septic systems in the community						
Contaminated water in residential yards	28	0	14	21	14	24
Contaminated water in local drainages	28	7	7	17	24	17
Contaminated water flow between properties	34	3	10	10	21	21
Downstream water quality impacts in Woodacre, San Geronimo and Lagunitas Creeks	28	3	10	14	24	21
Odors or other nuisance conditions	31	7	10	14	14	24
Public health issues from observed rainy season septic system problems at neighboring properties	24	7	10	17	17	24
Other? ___________________________________						

Issues and Levels of Concern – Overall Total (%)

Issue	Level of Concern Low 1	2	Medium 3	4	High 5	None
1. Condition, age, functioning of your existing septic system						
Operation in normal rainfall years	46	5	21	10	5	13
Operation in high rainfall years	33	8	14	10	25	11
Operation in the summer	55	15	10	4	3	14
For possible selling or refinancing	35	10	9	9	23	15
For possible house or property improvements	33	6	13	5	28	16
Other? ___________________________________						
2. Code compliance, non-conforming, or non-documented status of your existing septic system						
For possible selling or refinancing	39	5	13	1	26	16
For possible house or property improvements	36	3	16	0	26	19
Other? ___________________________________						
3. General interference of your existing septic system with use and enjoyment of your property						
For current uses	46	11	15	8	5	15
For possible house or property improvements	31	9	16	8	19	18
4. Public health and water quality impacts from yours and/or other septic systems in the community						
Contaminated water in residential yards	29	8	14	16	19	15
Contaminated water in local drainages	29	5	14	13	29	11
Contaminated water flow between properties	33	8	11	13	23	14
Downstream water quality impacts in Woodacre, San Geronimo and Lagunitas Creeks	24	8	10	13	34	13
Odors or other nuisance conditions	30	13	13	13	16	16
Public health issues from observed rainy season septic system problems at neighboring properties	31	3	10	16	25	15
Other? ___________________________________						

Site Conditions - ZONE 1 (%)

Site Condition	Constraint Level N/A	Low	Med	High	None
Shallow winter water table/soil saturation	10	23	20	37	10
Poor soil permeability	17	13	17	37	17

Poor surface water drainage	13	23	17	30	17
Shallow bedrock/clay layer	13	13	20	30	23
Steep slope	33	20	10	7	30
Insufficient area	23	23	13	10	30
Inadequate setbacks to drainages/streams	40	13	13	7	27
Other? ______________________________					

Site Conditions (% - ZONE 2)

Site Condition	Constraint Level				None
	N/A	Low	Med	High	
Shallow winter water table/soil saturation	16	21	21	11	32
Poor soil permeability	11	37	11	5	37
Poor surface water drainage	11	32	16	0	42
Shallow bedrock/clay layer	16	32	11	5	37
Steep slope	32	26	5	5	32
Insufficient area	21	16	21	11	32
Inadequate setbacks to drainages/streams	16	21	5	11	47
Other? ______________________________					

Site Conditions - ZONE 3 (%)

Site Condition	Constraint Level				None
	N/A	Low	Med	High	
Shallow winter water table/soil saturation	21	10	0	21	48
Poor soil permeability	24	7	7	17	45
Poor surface water drainage	24	3	10	14	48
Shallow bedrock/clay layer	28	10	0	14	48
Steep slope	28	17	3	3	48
Insufficient area	34	3	3	10	48
Inadequate setbacks to drainages/streams	28	10	3	10	48
Other? ______________________________					

Site Conditions - Overall Total (%)

Site Condition	Constraint Level				None
	N/A	Low	Med	High	
Shallow winter water table/soil saturation	16	18	13	24	30
Poor soil permeability	19	16	11	21	33

Poor surface water drainage	18	18	14	16	35
Shallow bedrock/clay layer	20	16	10	18	36
Steep slope	31	20	6	5	38
Insufficient area	28	14	11	10	38
Inadequate setbacks to drainages/streams	30	14	8	9	40
Other? ______________________________					

Woodacre Wastewater Questionnaire Survey
Wastewater Management Preferences
Summary of Results - # of Respondents

Wastewater Management Alternative	Highest Preference					Lowest Preference	
	1st	2nd	3rd	4th	5th	6th	No Ranking
a) **No Project – status quo**	9	2	0	1	1	40	27
b) **Onsite Management/Upgrade Program** - oversight and financing program for upgrades to existing OWTS	8	3	2	2	29	8	28
c) **Primary Treatment & Leachfield** - STEP/STEG effluent collection system - year-round leachfield at Dickson Ridge	8	2	4	26	6	7	27
d) **Secondary Treatment & Leachfield** - STEP/STEG effluent collection system - secondary treatment at Dickson Ranch - year-round leachfield at Dickson Ridge	11	6	27	3	2	4	27
e) **Secondary Treatment, Recycling & Leachfield** - STEP/STEG effluent collection system - secondary treatment at Dickson Ranch - winter leachfield at Dickson Ridge - seasonal recycled water for pasture/open space irrigation & other secondary uses	10	28	6	3	2	4	27
f) **Tertiary Treatment, Recycling & Leachfield** - STEP/STEG effluent collection system - tertiary treatment at Dickson Ranch - winter leachfield at Dickson Ridge - seasonal recycled water for landscape and pasture irrigation & other tertiary uses	27	3	9	6	2	5	28

Appendix D

Wastewater Collection Systems

APPENDIX D
SMALL-DIAMTER EFFLUENT STEG/STEP SEWER

INTRODUCTION

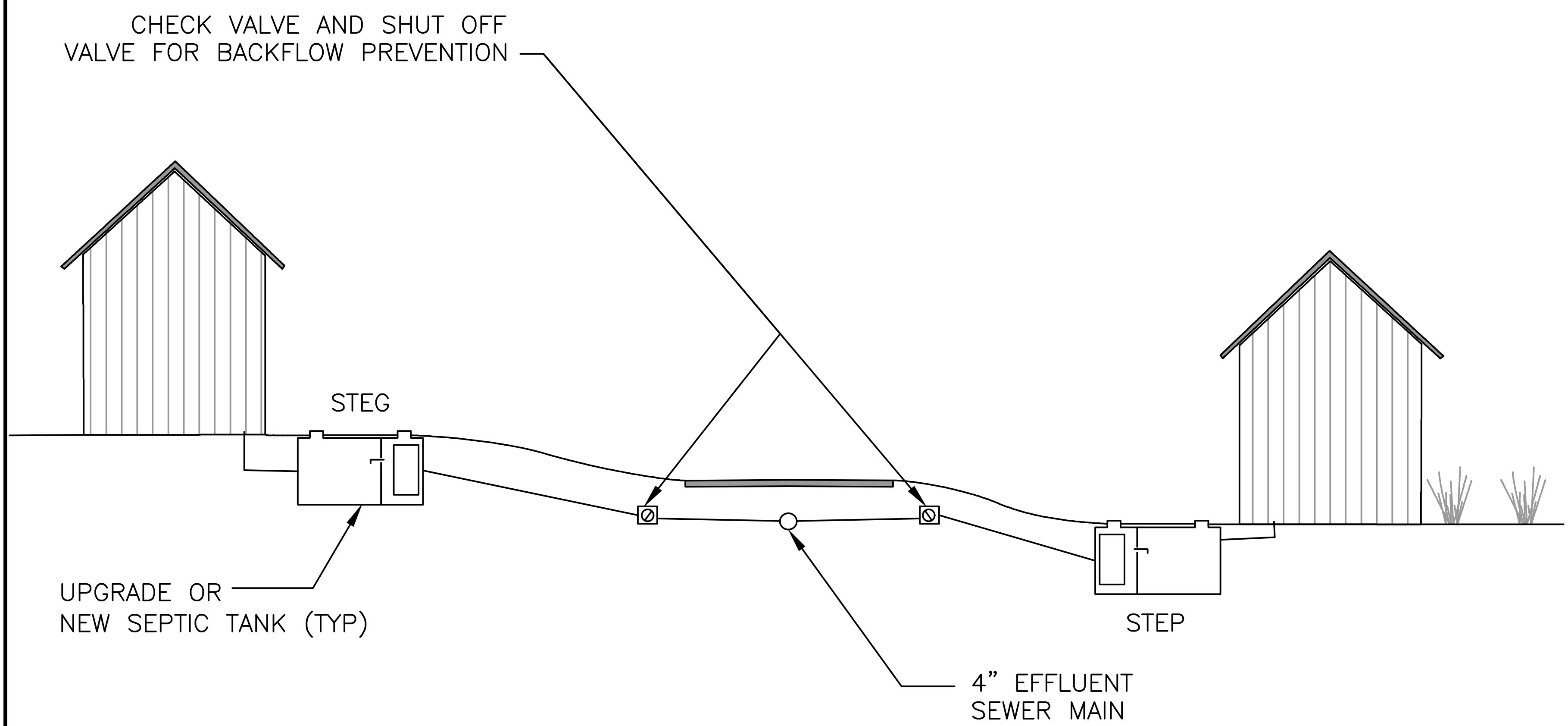
The 2011 Woodacre Flats Wastewater Feasibility Study included a comparative review and evaluation of alternative sewer collection methods in conjunction with a community wastewater system for Woodacre. These included:

- **Conventional Gravity Sewer**. In a conventional gravity sewer, untreated wastewater travels through a system of sewer pipes installed at a minimum grade to maintain gravity flow. Sewer pipes are usually six or eight-inch minimum diameter, with four-inch diameter lateral connections from buildings. Manholes provide access for maintenance and cleaning. Individual pumps may be required for buildings located downhill from the street sewer.

- **Pressure Sewer.** A pressure sewer consists of small diameter pipes (typically 2 to 4 inches), which are installed following the profile of the ground. In residential areas served by a pressure sewer, each home uses a small grinder pump to discharge to the main line. The pump grinds the solids in the wastewater into slurry in the manner of a kitchen sink garbage grinder.

- **Effluent STEG/STEP Sewer.** In effluent sewer systems primary treatment is provided at each connection by a septic tank, and only the settled wastewater (liquid portion) is collected. The collection lines consist of small diameter pipe similar to pressure sewers (typically, 2 to 4 inches) and the pipe is installed following the profile of the ground. Where the terrain is appropriate, the septic tank effluent can be collected by gravity flow (septic tank effluent gravity, "STEG"). Where the terrain is flat, undulating or slopes uphill, individual pumping units (septic tank effluent pump, "STEP") is used. In these cases, each connection includes an effluent pump located either in the second compartment of the septic tank or in a separate pump chamber. See **Figures D-1** and **D-2**.

The wastewater collection systems analysis determined that all the above collection methods are feasible in Woodacre and concluded that the preferred option for project alternatives utilizing a community leachfield system would be an Effluent STEG/STEP Sewer system. This recommendation is based on several factors, including: (a) lower cost; (b) ability to limit entry of extraneous water into the sewer system from groundwater/rainwater infiltration and inflow (I/I); (c) reduced maintenance needs; (d) overall reliability for emergency situations; and (e) least disruptive method of construction. In comparison, conventional gravity sewers expose the collection system to higher amounts of I/I through pipe connections and manholes. The high groundwater conditions in Woodacre service area would make a conventional gravity sewer highly vulnerable to I/I, which would be damaging for a community leachfield system, putting greater stress on limited soil absorption capacity. Effluent sewers use small diameter pipe, with glued, fuse or threaded fittings, and have cleanouts but no manholes. The



Date:	8/12/24
Drawn:	ER
Appr'd:	NH
Project No:	2200054

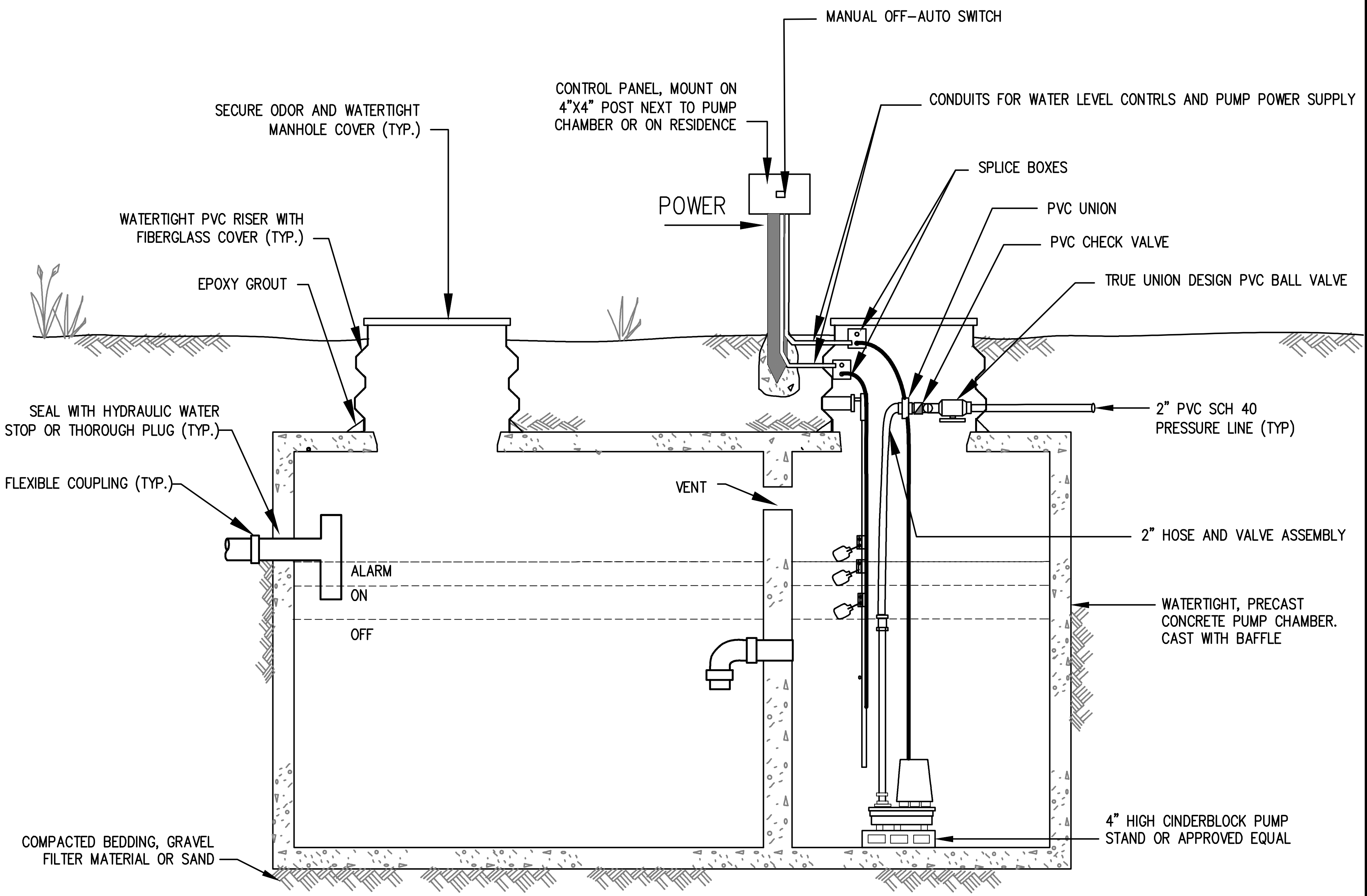
QUESTA ENGINEERING CORP.
Civil Environmental & Water Resources
(510) 236-6114
FAX (510) 236-2423
questa@questaec.com
P.O. Box 70356 1220 Brickyard Cove Road Point Richmond, CA 94807

TYPICAL STEG/STEP EFFLUENT SEWER SYSTEM

WOODACRE WASTEWATER FEASIBILITY STUDY

FIGURE

D-1



Date:	8/12/24
Drawn:	ER
Appr'd:	NH
Project No:	2200054

QUESTA ENGINEERING CORP
Civil Environmental & Water Resources
(510) 236-6114
FAX (510) 236-2423
questa@questaec.com
P.O. Box 70356 1220 Brickyard Cove Road Point Richmond, CA 94807

TYPICAL SEPTIC TANK WITH EFFLUENT PUMP (STEP)

WOODACRE WASTEWATER FEASIBILITY STUDY

FIGURE D-2

increased energy requirements and costs of pumping unnecessary I/I uphill to the Dickson Ridge leachfield area could be significant.

DESCRIPTION AND APPLICBILITY TO WOODACRE

For an Effluent STEG/STEP system, each property in the Service Area would retain an on-lot septic tank for primary treatment, and the clarified effluent would be conveyed from the tank to a network of small diameter effluent collection lines extending throughout the service area. The connection to the effluent sewer system would be either by gravity (STEG) or with a pump unit (STEP) located in the second compartment of the septic tank or an adjacent pump basin. Based on the gently sloping terrain of the Woodacre study area, it is estimated about 80 percent of the properties could be served by STEG connections, with up to about 20% requiring a STEP unit to pump into the main sewer collection line. STEG and STEP effluent lines would be installed typically at a minimum depth of 3 to 5 feet in the street or as needed to provide at least one foot clearance below existing water mains and service laterals.

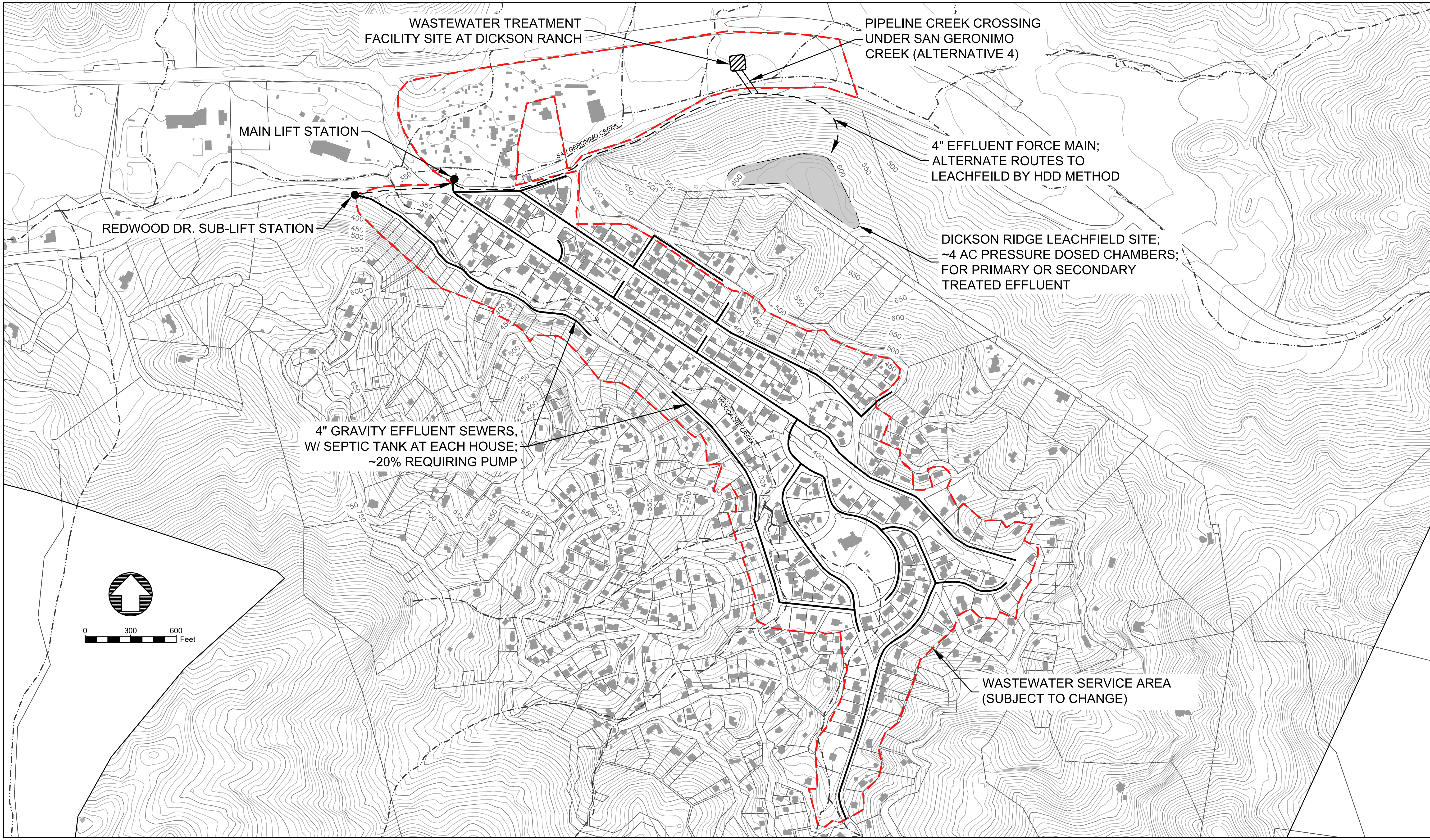
Gravity effluent sewer lines would be installed on most all the streets in the service area as diagrammed in **Figure D-3**. Most of the flow would go to main collector lines on Railroad Ave and Central Ave leading to a main lift station located on the northeast corner of Railroad Ave and San Geronimo Valley Drive (**Figure D-4**). From the main lift station, the septic tank effluent would be pumped via an effluent force main (pressure line) to either: (a) the community leachfield on Dickson Ridge (Alternative 3) or to the wastewater treatment plant located on the Dickson Ranch property (Alternatives 4 and 5).

Because of the undulating grade on Redwood Ave and recent (2021) slide impacting the street, the effluent collection line on Redwood Avenue is proposed to include: (a) a gravity section draining to the foot of Redwood Ave at San Geronimo Valley Dr; and (b) a pressure (STEP) section for the properties located south of the slide, that would tie into the main effluent sewer on Carson Rd. Accordingly, some of the properties along Redwood would have STEG units and some would require STEP connections. For the gravity line, there would be a small sub-lift station near the San Geronimo Valley Dr intersection, from which the collected effluent would be pumped to the main lift station at Railroad and San Geronimo Valley Dr (**Figure D-5**).

FACILITY REQUIREMENTS

Per the preliminary layout, the facility requirements of the effluent STEG/STEP sewer option include the following:

- **Septic Tanks.** Watertight septic tanks would be required for each property (some commercial or multi-residential properties might have more than one tank). Based on prior septic systems inspections (Rosefield and Trienen, 2004-05 and 2007-08) along with field and file reviews by Questa, we estimate that no more than about 25% of existing septic tanks could be salvaged and continue to be utilized; due to their age, size and condition about 75% of the existing septic tanks would have to



PLOT STYLE: ----

LAST SAVED: 8/12/2024 PLOT DATE: 8/12/2024

WOODACRE WASTEWATER FEASIBILITY STUDY

WOODACRE, CA

QUESTA ENGINEERING CORP.

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Sht:	Rev:	Date:	By:	Description:	App'd:

Design: NH
Drawn: ER
Checked: NH
Appr'd: NH

SEWER SYSTEM OVERVIEW

WOODACRE, CA

FIGURE

D-3

IF BAR DOES NOT MEASURE 1" DRAWING IS NOT TO SCALE – ADJUST ACCORDINGLY

Date:	8/12/24
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MAIN LIFT STATION LOCATION
WOODACRE WASTEWATER FEASIBILITY STUDY

FIGURE
D-4

Date:	8/12/24
Drawn:	ER
Appr'd:	NH
Project No:	2200054

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REDWOOD DR. LIFT STATION LOCATION
WOODACRE WASTEWATER FEASIBILITY STUDY

FIGURE
D-5

be replaced with new tanks. All tanks would require watertight access risers. Any existing tanks that remain in service would be subject to inspection and testing to verify their conformance with minimum standards and functionality for continued use.

- **STEP and STEG Units.** We estimate that approximately 20% of the properties (50 systems) in the service area would require pumping (STEP) units. All others would accommodate gravity connections and would be classified as STEG units. The STEP unit includes a submersible effluent pump installed in a separate tank following the septic or in the second compartment of the septic tank, along with associated electrical control and float-activated switches programmed to operate on demand (i.e., in response to flow from the property). Power is supplied from the house or commercial building electrical service, where an audio and visual alarm is located. Emergency/reserve storage capacity of about 150 gallons is normally provided in the septic tank for pump malfunction or power outages. STEG units would have no additional equipment requirements other than a standard septic tank with access risers and effluent filter.

- **Service Laterals.** Every property would have a service lateral connection to the effluent sewer line in the street. Service laterals for STEG units would be 4-inch diameter lines. Service laterals connecting the STEP unit to the collection main are usually 1.25-inch for pressure lines for residences and 1.5 or 2-inch diameter for commercial and multi-family connections All piping and valves are typically PVC (Schedule 40 of 80). A check valve and shutoff valve would be installed on each service lateral at the property line to prevent backflow of effluent from the public sewer into the on-lot facilities in the event of any problem or maintenance work on the sewer main.

- **Gravity Effluent Sewer Lines.** Approximately 14,500 lineal feet of 4-inch diameter gravity effluent sewers would be required to serve the entire Woodacre service area (250 properties). Effluent sewers would be HDPE pipe (high density polyethylene).

- **STEP Sewers.** Approximately 4,000 lineal feet of STEP sewers would be required, primarily along Redwood Dr. STEP sewers would be 2-inch or 3-inch diameter HDPE pipe.

- **Clean-Outs.** Manholes are not required in STEG/STEP sewers; clean-outs and isolation valves are included for maintenance purposes.

- **Redwood Dr Sub-Lift Station.** The sub-lift station at the foot of Redwood Dr would consist of buried tank (approximately 5,000 gallons capacity) with small, submersible duplex (2) pumps (0.5 hp), and electrical controls housed in an adjacent secure enclosure. The lift station would be designed for emergency operation using portable generator power.

- **Main Lift Station.** The main effluent lift station would be located in the road shoulder right-of-way area on the northeast corner of the Railroad Ave and San Geronimo Valley Dr intersection. It would consist of a large, buried pump tank, with duplex (2) submersible pumps; electrical controls would be housed in an adjacent structure alongside a standby emergency generator for automatic operation. Preliminary design anticipates a fiberglass pump tank up to about 20,000-gallons capacity, approximately 40-ft long and 10-ft in diameter, with access at grade provided by standard sewer manholes. The electrical control structure and emergency generator would have security fencing around them. The lift station would be more than 100-ft from San Geronimo Creek (top of bank) and outside the 100-yr flood hazard zone.

ESTIMATED COSTS

Estimated construction costs for the STEG/STEP effluent sewer system are presented in **Tables D-1** through **D-4**, respectively, for 100, 150, 200 and 250 service connections, and summarized in **Table D-5** below. Included are estimated quantities and unit cost assumptions, The quantities were taken directly from the preliminary sewer plan layout (**Figure D-3**). Unit costs for on-lot facilities include the cost of materials and installation of STEG/STEP units, new septic tanks or upgrade of existing tanks, and the excavation and installation of building sewers and service laterals. Unit costs for the collection system include material costs for sewer pipes and valves, trench excavation, pipeline installation, backfilling, pavement repair, and clean-up. The collection method, soil conditions and terrain in the Woodacre service area are suitable for sewer installation using horizonal directional drilling (HDD), which is reflected in our estimates for pipeline installation. The costs for abandonment of existing septic tanks and any re-routing of house plumbing would be an individual property owner cost and not part of the community system cost. The estimated costs for this additional property-owner expense are noted in each of the tables.

Table D-5. Summary of Collection System Cost Estimates

# of Connections	Estimated Community Sewer Costs	Estimated On-lot Facilities Costs	Estimated Total Collection System Costs	Estimated Cost per Connection
100	$3,188,500	$1,644,000	$4,832,500	$48,325
150	$3,567,200	$2,235,000	$5,802,200	$38,681
200	$4,606,700	$3,120,000	$7,726,700	$38,634
250	$5,026,700	$4,005,000	$9,031,700	$36,127

Table D-1. Woodacre Effluent Sewer Collection Cost Estimate
100 Connections

Parcels: 100 **Design Flow: 13,500 gpd**

Community Sewer Facilities				
Description	**Units**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
2-inch Pressure Sewer & appurtenances	LF	2,000	$ 120	$ 240,000
3-inch Pressure Sewer & appurtenances	LF	1,000	$ 120	$ 120,000
4-inch Gravity Effluent Sewer & appurtenances	LF	7,250	$ 150	$ 1,087,500
Effluent Lift Station at Redwiid Ave/SGV Dr	LS	1	$ 75,000	$ 75,000
Effluent Lift Station at RR Ave/SGV Dr	LS	1	$ 200,000	$ 200,000
4-inch Force Main on SGV Dr	LF	2,600	$ 175	$ 455,000
4-inch Force Main - Overland	EA	1,000	$ 100	$ 100,000
			Community Collection Subtotal	$ 2,277,500
			Miscellaneous & Contingency @ 20%	$ 455,500
			Engineering & Permitting @ 20%	$ 455,500
			Collection System Total	**$ 3,188,500**
			Cost per Parcel	**$ 31,885**

Individual On-lot Facilites (assumed eligble for funding)				
Description	**Unit**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
New STEG Unit	EA	50	$ 10,000	$ 500,000
Upgrade Existing Tank to STEG Unit	EA	15	$ 7,500	$ 112,500
New STEP Unit	EA	35	$ 15,000	$ 525,000
Gravity Laterals, 4" dia; ave 50 LF @ $50/LF	EA	65	$ 2,500	$ 162,500
Pressure STEP Laterals, 1.25", ave50 feet @ $40/lf	EA	35	$ 2,000	$ 70,000
			On-lot Collection Sub-total	$ 1,370,000
			Contingency @ 20%	$ 274,000
			Engineering & Permitting @ 20%	$ 274,000
			On-Lot Facilities Total	**$ 1,644,000**
			Estimated Cost per Parcel	**$ 16,440**

TOTAL ESTIMATED CONSTRUCTION COST	**$ 4,832,500**
ESTIMATED COST PER CONNECTION	**$ 48,325**

Owner Costs for Tank Abandonment and Plumbing Work				
Septic Tank Abandonment	EA	85	$ 3,000	$ 255,000
Reroute House Plumbing	EA	85	$ 1,500	$ 127,500
			Total	**$ 382,500**
			Average Cost Per Parcel	**$ 4,500**

Table D-2. Woodacre Effluent Sewer Collection Cost Estimate
150 Connections

Parcels: 150 **Design Flow: 20,250 gpd**

Community Sewer Facilities				
Description	**Units**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
2 &3-inch Pressure Sewer & appurtenances	LF	3,000	$ 120	$ 360,000
4-inch Gravity Effluent Sewer & appurtenances	LF	9,500	$ 150	$ 1,425,000
Effluent Lift Station at Redwiid Ave/SGV Dr	LS	1	$ 75,000	$ 75,000
Effluent Lift Station at RR Ave/SGV Dr	LS	1	$ 250,000	$ 250,000
4-inch Force Main on SGV Dr	LF	2,600	$ 130	$ 338,000
4-inch Force Main - Overland to LF	EA	1,000	$ 100	$ 100,000
4" FM - SG Creek Xing - (350' two ways)	LF	0	$ 150	$ -
			Community Collection Subtotal	$ 2,548,000
			Miscellaneous & Contingency @ 20%	$ 509,600
			Engineering & Permitting @ 20%	$ 509,600
			Collection System Total	**$ 3,567,200**
			Cost per Parcel	**$ 23,781**

Individual On-lot Facilites (assumed eligble for funding)				
Description	**Unit**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
New STEG Unit	EA	75	$ 10,000	$ 750,000
Upgrade Existing Tank to STEG Unit	EA	50	$ 7,500	$ 375,000
New STEP Unit	EA	25	$ 15,000	$ 375,000
Gravity Laterals, 4" dia; ave 50 LF @ $50/LF	EA	125	$ 2,500	$ 312,500
Pressure STEP Laterals, 1.25", ave50 feet @ $40/lf	EA	25	$ 2,000	$ 50,000
			On-lot Collection Sub-total	$ 1,862,500
			Contingency @ 20%	$ 372,500
			Engineering & Permitting @ 20%	$ 372,500
			On-Lot Facilities Total	**$ 2,235,000**
			Cost per Parcel	**$ 14,900**

TOTAL ESTIMATED CONSTRUCTION COST	**$ 5,802,200**
ESTIMATED COST PER CONNECTION	**$ 38,681**

Owner Costs for Tank Abandonment and Plumbing Work				
Septic Tank Abandonment	EA	100	$ 3,000	$ 300,000
Reroute House Plumbing	EA	100	$ 1,500	$ 150,000
			Total	**$ 450,000**
			Average Cost Per Parcel	**$ 4,500**

Table D-3. Woodacre Effluent Sewer Collection Cost Estimate
200 Connections

Parcels: 200 **Design Flow: 27,000 gpd**

Community Sewer Facilities				
Description	**Units**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
3-inch Pressure Sewer & appurtenances	LF	4,000	$120	$ 480,000
4-inch Gravity Effluent Sewer & appurtenances	LF	12,500	$150	$ 1,875,000
Effluent Lift Station at Redwiid Ave/SGV Dr	LS	1	$ 75,000	$ 75,000
Effluent Lift Station at RR Ave/SGV Dr	LS	1	$ 300,000	$ 300,000
4-inch Force Main on SGV Dr	LF	2,600	$ 130	$ 338,000
4-inch Force Main - Overland to LF	EA	1,000	$ 100	$ 100,000
4" FM - SG Creek Xing - (350' two ways)	LF	700	$ 175	$ 122,500
			Community Collection Subtotal	$ 3,290,500
			Miscellaneous & Contingency @ 20%	$ 658,100
			Engineering & Permitting @ 20%	$ 658,100
			Collection System Total	**$ 4,606,700**
			Cost per Parcel	**$ 23,034**

Individual On-lot Facilites (assumed eligble for funding)				
Description	**Unit**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
New STEG Unit	EA	100	$10,000	$ 1,000,000
Upgrade Existing Tank to STEG Unit	EA	50	$7,500	$ 375,000
New STEP Unit	EA	50	$15,000	$ 750,000
Gravity Laterals, 4" dia; ave 50 LF @ $50/LF	EA	150	$2,500	$ 375,000
Pressure STEP Laterals, 1.25", ave50 feet @	EA	50	$2,000	$ 100,000
			On-lot Collection Sub-total	$ 2,600,000
			Contingency @ 20%	$ 520,000
			Engineering & Permitting @ 20%	$ 520,000
			On-Lot Facilities Total	**$ 3,120,000**
			Cost per Parcel	**$ 15,600**

TOTAL ESTIMATED CONSTRUCTION COST	**$ 7,726,700**
ESTIMATED COST PER CONNECTION	**$ 38,634**

Owner Costs for Tank Abandonment and Plumbing Work				
Septic Tank Abandonment	EA	150	$3,000	$ 450,000
Reroute House Plumbing	EA	150	$1,500	$ 225,000
			Total	**$ 675,000**
			Average Cost Per Parcel	**$ 4,500**

Table D-4. Woodacre Effluent Sewer Collection Cost Estimate
250 Connections

Parcels: 250 **Design Flow: 33,750 gpd**

Community Sewer Facilities				
Description	**Units**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
2 & 3-inch Pressure Sewer & appurtenances	LF	4,000	$ 120	$ 480,000
4-inch Gravity Effluent Sewer & appurtenances	LF	14,500	$ 150	$ 2,175,000
Effluent Lift Station at Redwiid Ave/SGV Dr	LS	1	$ 75,000	$ 75,000
Effluent Lift Station at RR Ave/SGV Dr	LS	1	$ 300,000	$ 300,000
4-inch Force Main on SGV Dr	LF	2,600	$ 130	$ 338,000
4-inch Force Main - Overland to LF	EA	1,000	$ 100	$ 100,000
4" FM - SG Creek Xing - (350' two ways)	LF	700	$ 175	$ 122,500
			Community Collection Subtotal	$ 3,590,500
			Miscellaneous & Contingency @ 20%	$ 718,100
			Engineering & Permitting @ 20%	$ 718,100
			Collection System Total	**$ 5,026,700**
			Cost per Parcel	**$ 20,107**

Individual On-lot Facilites (assumed eligble for funding)				
Description	**Unit**	**Est Qty**	**Unit Cost ($)**	**Total Cost ($)**
New STEG Unit	EA	125	$10,000	$ 1,250,000
Upgrade Existing Tank to STEG Unit	EA	50	$7,500	$ 375,000
New STEP Unit	EA	75	$15,000	$ 1,125,000
Gravity Laterals, 4" dia, ave 50 LF @ $50/LF	EA	175	$2,500	$ 437,500
Pressure STEP Laterals, 1.25", ave 50 lf	EA	75	$2,000	$ 150,000
			On-lot Collection Sub-total	$ 3,337,500
			Contingency @ 20%	$ 667,500
			Engineering & Permitting @ 20%	$ 667,500
			On-Lot Facilities Total	**$ 4,005,000**
			Cost per Parcel	**$ 16,020**

TOTAL ESTIMATED CONSTRUCTION COST	**$ 9,031,700**
ESTIMATED COST PER CONNECTION	**$ 36,127**

Owner Costs for Tank Abandonment and Plumbing Work				
Septic Tank Abandonment	EA	200	$3,000	$ 600,000
Reroute House Plumbing	EA	200	$1,500	$ 300,000
			Total	**$ 900,000**
			Average Cost Per Parcel	**$ 4,500**

Appendix E

Dickson Ridge Field Studies

APPENDIX E

DICKSON RANCH COMMUNITY LEACHFIELD SITE

The following information regarding site conditions for suitability assessment for a community leachfield at the Dickson Ridge site includes data and findings from the 2011 Woodacre Flats Wastewater Feasibility Study supplemented with more detailed exploration, survey and testing during 2023 as part of the current Woodacre Wastewater Feasibility Study.

Site Conditions

As part of the 2011 Woodacre Flats Wastewater Feasibility Study, field reconnaissance investigations were conducted on several large properties in the Woodacre area to identify sites that might be suitable and of sufficient size to accommodate a community wastewater disposal system. A few potential sites were located on the Dickson Ranch property and on lands owned by the Tamalpais Union High School District, east of Woodacre. Based on the amount of area, soil conditions, and landowner interests and concerns, the most promising site identified was a wooded knoll on Dickson Ranch property located along the Fire Road ridgeline. This area (now referred to as the Dickson Ridge site) was initially estimated to have about 1.5-acres of suitable area to accommodate a community leachfield system, sufficient to serve the Woodacre Flats area. As part of the current study, in 2023 the Dickson Ridge site was investigated in more detail and with better topographic information was determined to offer up to 3.4 acres of potentially suitable area for wastewater disposal (leachfields).

The Dickson Ridge site was initially identified as a potential area of interest from review of air photos, and topographic and geologic maps. It lies on a portion of the ridgeline composed of sandstone. The area considered suitable for a community leachfield is about a 3.4-acre knoll and adjacent slopes, extending approximately 1,000-feet along the ridgeline in a southeast-northwest direction, sloping predominantly to the north and northeast at grades varying from about 5 to 35 percent. A small portion of the site (estimated 5 to 10 percent) drains in a southwesterly direction toward Woodacre and would not be considered for leachfield use. Further north of the knoll, the slopes steepen considerably to greater than 40%, which continue downhill to San Geronimo Valley Drive. The knoll is wooded, mostly with bay trees, oaks, madrone, Douglas fir, and redwoods. There is a limited amount of understory vegetation. The steeper hillslopes to the north and northeast are densely wooded, with predominantly with redwoods and Douglas fir. There is no development on the site or on any lands between the site and San Geronimo Valley Drive.

Figure E-1 is topographic map of the site on which the locations of trees have been added based on field surveys conducted by Questa Engineering in 2023. An tree survey was also conducted by a professional arborist (report attached from Arborsciene attached). Based on arborist recommendations, setback areas around all protected trees are shown on the map. The map also shows the location of soils and percolation testing conducted by Questa Engineering in 2010 and February 2023.

As a result of its topographically high position, there are no watercourses on or within 100 feet of the Dickson Ridge site studied for wastewater disposal. It is evident that rainfall on the site is retained and percolates readily through the heavy covering of forest litter and permeable surface soils. Any runoff that occurs is dispersed by sheet flow and is slowed by the vegetative cover.

Farther down the hillslope to the north and northeast, swales form which eventually become seasonal drainages at the base of the hillslope near San Geronimo Valley Drive. There are no known wells on the site or in the immediate vicinity. The nearest well an agricultural supply well located approximately 600 feet to the southeast.

2010 Soil Profiles. Following initial hand-auger soils inspection, four exploratory test pits were excavated in the Dickson Ridge site Questa on June 4, 2010, to evaluate soil suitability for wastewater disposal. Test pit locations are shown in Figure E-1. All test pits showed similar soil conditions, consisting of loam and sandy loam topsoils underlain by highly weathered sandstone to the depth explored. No groundwater or evidence of seasonal saturation was observed in any of the profiles. **Table E-1** summarizes these three initial soil profiles logs.

Table E-1: Soil Profile Summary, Dickson Ridge Site
June 4, 2010

Test Pit #	Depth (inches from surface)	Soil Description
T-1	0 - 21	Loam
	21 - 66	Very weathered sandstone
	66 - 90	Very weathered sandstone, increasing density
T-2	0 – 24	Fine sandy loam
	24 – 66	Highly weathered sandstone; textures to sandy clay loam
	66 - 78	Weathered sandstone, very soft and friable
T-3	0 - 16	Loam to sandy loam
	16 – 72	Weathered sandstone, variable from sandy loam to sandy clay
T-4	0 – 28	Sandy loam
	28 - 60	Very weathered sandstone; textures to sandy loam

February 2023 Soil Profiles. In February 2023, following a period of heavy rainfall (17.65 inches between January 1st and February 7th), Questa conducted additional soils and percolation testing at the Dickson Ridge site. With the benefit of more detailed topography not available in 2010, Questa was able to expand and assess a larger area. The testing area was extended downhill in a northerly direction down. The locations of the additional soil profile test pits and percolation test holes are shown in **Figure E-1**; the soil profile observations are summarized in **Table E-2**. Test pits ranged from 5 to 9.5 feet in depth.

Table E-2: Soil Profile Summary, Dickson Ridge Site
February 7,2023

Test Pit #	Depth (inches from surface)	Soil Description
T-1	0 - 13	Loam
	13 - 33	Sandy clay loam (light density)
	33 - 44	Light density clay (sandy)
	44 - 84	Very weathered sandstone, textures as sandy loam to sandy clay loam
T-2	0 - 9	Sandy loam
	9 - 43	Sandy clay loam (light density)
	43 - 96	Very weathered sandstone, textures as sandy loam to sandy clay loam
T-3	0 - 34	Sandy loam
	34 - 45	Sandy clay loam (very weathered sandstone)
	45 - 56	Sandy clay
	56 - 84	Very weathered sandstone, textures as sandy loam to sandy clay loam
T-4	0 - 23	Sandy loam
	23 - 38	Sandy clay loam
	38 - 102	Weathered sandstone
T-5	0 - 8	Loam
	8 - 15	Sandy clay loam
	15 - 27	Sandy clay (fairly stiff; not suitable)
	27 - 58	Differentially weathered sandstone (much weathered to clay; not suitable)

The additional soil profiles in 2023 showed conditions similar to the 2010 testing, typically about 3 to 3.5 feet of sandy to sandy clay loam transitioning to friable and highly weathered sandstone which underlies the entire area. One of the test pits (T-5) on the southeastern side of the site showed a very shallow surface soil depth (8 inches) above stiff sandy clay; this area was excluded from consideration for use as a leachfield.

Despite the heavy antecedent rainfall in January and early February 2023, no groundwater was observed in any of the test pits.

Percolation Testing. No percolation testing was conducted during the 2010 investigation of the Dickson Ridge site. To provide necessary information for detailed assessment of leachfield disposal capacity, wet weather tests were conducted on February 7, 2023. Testing included 9 tests at 30 inches depth (proposed trench depth) and 4 tests at 60 to 72 inches in the underlying weathered sandstone.

- 30-inch Tests. Two of the test holes (#1 & #10) were in areas of shallow clay soil and failed to drain; the area of these tests was excluded from leachfield consideration. The average of the other 7 tests at 30 inches was 19.4 MPI.

- 60 & 72-inch Tests. The 4 deeper tests (P-2, 4, 8 & 12) in the weathered sandstone showed much slower percolation, less than 1/16 to 3/16 of an inch drop per hour. These tests demonstrate the weathered sandstone has some absorption capacity, but is not suitable for deep leaching trenches.

Recommendation. The recommended leachfield design is a shallow, 30-inch deep pressure distribution trench system, ideally utilizing high capacity infiltrator chambers with 3 to 4 inches of drain rock base and pressure piping strapped along the sofit. Maintain minimum lateral setbacks to trees per Arborist's recommendation (3x to 6x BHD).

Table E-3. Percolation Test Results at Dickson Ridge
February 7, 2023

Test Hole Number	***Depth (inches)***	***Inches/hour***	***Stabilized Percolation Rate***	***Comments***
			MPI	
P-1	30	<0.0625	Ø	test hole area excluded
P-2	60	0.1875	320	
P-3	30	7.25	8.3	
P-4	60	<0.0625	Ø	
P-5	30	21	2.9	
P-6	30	1.5	40	
P-7	30	1.5	40	
P-8	60	<0.0625	Ø	
P-9	30	8.5	7.1	
P-10	30	0.25	240	test hole area excluded
P-11	30	2.0	30	
P-12	72	<0.0625	Ø	
P-13	30	7.75	7.7	
Average Stabilized Percolation Rate – 30" Depth (Test Holes P-3, 5, 6, 7, 9, 11, 13)			**19.3 MPI**	

WOODACRE-SAN GERONIMO WASTEWATER STUDY

WOODACRE, CA

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Sht:	Rev:	Date:	By:	Description:	App'd:

Design: NH
Drawn: ER
Checked: NH
Appr'd: NH

DICKSON RIDGE LEACHFIELD AREA TEST LOCATIONS

FIGURE E-1

ARBORIST REPORT

Proposed Woodacre Community Leachfield Site
(APN: 172-350-08)

Prepared for:
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March 23, 2023

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ASSIGNMENT

Questa Engineering Corporation hired ARBORSCIENCE, LLC to conduct a reconnaissance-level assessment of trees growing on the proposed Woodacre Community Leachfield Site. In addition to characterizing trees on the property, this report provides guidance on protecting trees during construction and lists County regulatory protection status for each species. I inspected the site on March 9, 2023.

SCOPE OF WORK AND LIMITATIONS

This assessment is based on the circumstances and observations, as they existed at the time of the site inspection. Opinions in this assessment are given based on observations made and using generally accepted professional judgment, however, because trees are living organisms and subject to change, damage and disease, the results, observations, recommendations, and analysis as set out in this assessment are valid only at the date any such observations and analysis took place and no guarantee, warranty, representation or opinion is offered or made by Arborscience as to the length of the validity of the results, observations, recommendations and analysis contained within this assessment. As a result the client shall not rely upon this Assessment, save and except for representing the circumstances and observations, analysis and recommendations that were made as at the date of such inspections.

SITE DESCRIPTION AND REGULATORY CONTEXT

The proposed Community Leachfield Site occupies the upper, north-facing portion of a 24.6-acre undeveloped parcel (APN: 172-350-08; rural unimproved zoning) that extends from San Geronimo Valley Drive to near the ridgeline (see attached map). The Marin County Code designates native trees as "protected" based on species and diameter at breast height (54" above grade).

Table 1. Protected trees by name and trunk diameter at 54" above grade.

Common Name	Scientific Name	Protected Tree Diameter (in.)
Coast Redwood	*Sequoia sempervirens*	10
Douglas-fir	*Pseudotsuga menziesii*	10
California bay	*Umbellularia californica*	10
Coast live oak	*Quercus agrifolia*	6
Tanoak	*Notholithocarpus densiflorus*	10
Pacific Madrone	*Arbutus menziesii*	6

SUBJECT TREE DESCRIPTIONS

The project area is a densely forested unmanaged hillside of trees that include coast redwood (*Sequoia sempervirens*), Douglas-fir (*Pseudotsuga menziesii*), California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), tanoak (*Notholithocarpus densiflorus*), and Pacific madrone (*Arbutus menziesii*). These trees regenerated following logging around the turn of the 20th Century, and after the 1923 wildfire that burned from Lucas Valley to Bolinas Ridge.

PROJECT TREE IMPACTS

The proposed project includes the installation of a 4-inch diameter transmission line from San Geronimo Valley Road (two alternates being considered) to two below-ground storage tanks located near the ridge in the eastern portion of the property, and a leach field. Transmission lines will be installed using horizontal directional drilling equipment; space for the tanks will be created by excavators, and leach lines will be placed in 3-ft wide by 2- to 3-ft deep trenches at 6- to 10-ft. spacings that will be created by backhoes along contours. This work will result in minor damage to tree roots and inadvertent damage to tree bark and limbs by heavy equipment operation. For the tree species involved, their tolerance to construction impacts ranges from good (coast redwood, Douglas-fir, coast live oak), through moderate (California bay), to poor (Pacific madrone). Construction impacts are expected to be minor to protected trees by following tree-protection measures outlined below. Operation of the septic system will dramatically improve tree health by providing nutrients and water. Removing unprotected trees (thinning) will improve forest health and reduce wildfire hazard to retained trees.

TREE-PROTECTION MEASURES

The following tree-protection measures will help minimize damage to protected trees in the project area:

1. Align leach lines to avoid protected trees for a radial distance that is at least three times their breast height trunk diameters. Additional space (six times their trunk diameters) should be provided for madrone trees that are least tolerant of construction impacts.

2. Use flagged stakes to mark proposed leach line alignments before excavation.

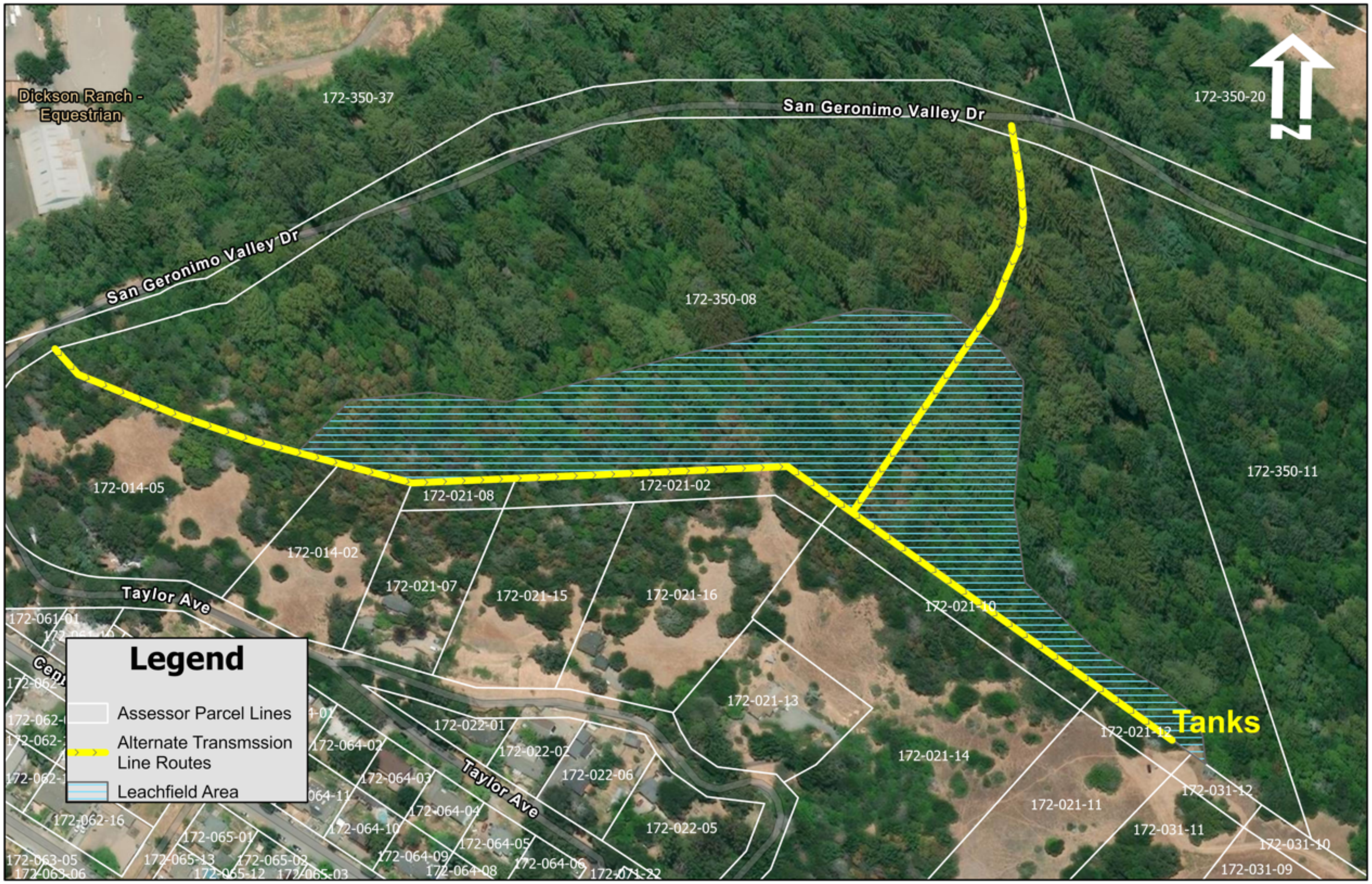
3. Schedule excavation work when soils are relatively dry to minimize compaction.

4. Cut roots greater than 2” in diameter with a clean, sharp saw in excavated trenches. Avoid ripping roots from the ground when possible.

5. Damaged trees (skinned bark and broken limbs) should be evaluated by a certified arborist and repaired as prescribed by the arborist.

Sincerely,
ARBORSCIENCE, LLC

Dr. Kent R. Julin
ISA Certified Arborist #WE-8733A
ISA Tree Risk Assessor Qualified
California Registered Professional Forester #2648



ARBORSCIENCE, LLC

Sound Tree Advice

0 125 250 500 Feet

Proposed Community Leachfield Site
Dickson Ranch Property
Woodacre, California

Appendix F

Nitrate Loading Analysis

Dickson Ridge Wastewater Disposal

ATTACHMENT F

Wastewater Nitrate Loading Analysis for Woodacre – Dickson Ridge Wastewater Disposal

METHODOLOGY

Wastewater nitrate loading analysis was completed using an annual chemical-water balance analysis. The methodology followed is described in the publication "Predicting Groundwater Nitrate-Nitrogen Impacts" (Hantzsche and Finnemore, *Groundwater*, Vol. 30, No. 4, July-August 1992). According to this methodology, the long-term concentration of nitrate as nitrogen (NO_3-N or nitrate-nitrogen) in the upper saturated groundwater zone can be closely approximated by the quality of percolating recharge waters. The average concentration of nitrate-nitrogen in recharge water, n_r, is estimated using the following equation:

$$n_r = \frac{W n_w (1-d) + R n_b}{(W+R)}$$

where:

n_r = resultant average concentration of NO_3-N in recharge water, mg-N/L

W = annual volume rate of wastewater entering the soil averaged, in acre-ft/yr (AFY)

n_w = total nitrogen concentration of wastewater, in mg-N/L

n_b = background NO_3-N concentration of rainfall recharge at the water table, exclusive of wastewater influences, in mg-N/L

d = fraction of NO_3-N loss due to denitrification in the dispersal area soil.

R = average annual volume of rainfall recharge within the project site, AFY

DATA AND ASSUMPTIONS

Per the equation presented above, resultant nitrate concentration in the groundwater is estimated to be the weighted average or combined concentration due to wastewater loading and deep percolation of rainfall contributed from the local drainage area within the area of concern.

The analysis includes construction of a water balance to estimate the average annual amount of rainfall-recharge occurring on the project site, coupled with a nitrate-nitrogen loading analysis combining the inputs from rainfall and onsite percolation of wastewater to estimate the resultant concentration of nitrate-nitrogen potentially impacting the groundwater. The following summarize the various assumptions.

- **Recharge Area.** The recharge area for the analysis is the 26-acre Dickson Ridge parcel that encompasses the proposed leachfield area. This is entirely comprised of woodland with a mixed forest including redwoods, douglas fir, bay laurel, madrone, coast live oak, tan oak and associated forest understory.

- **Wastewater Flows.** The nitrate loading analysis was completed for various project alternatives with varied wastewater flow assumptions for service areas ranging from 100 to 250 residential connections. Annual average wastewater flows were estimated for each scenario based on unit wastewater flows of 125 gpd per residence, assuming 2.5 persons per residence at 50 gal/day per person.

- **Wastewater Nitrogen Concentrations.** Total nitrogen concentration in wastewater effluent varies according to the level of treatment/nitrogen removal provided. Calculations were made as follows: (a) for dispersal of primary treated septic tank effluent, assuming effluent total nitrogen concentration of 60 mg-N/L; and (b) for dispersal of secondary-treated effluent, assuming effluent total nitrogen concentrations of 20, 25 and 30 mg-N/L.

- **Background Nitrogen Concentration.** A nominal value of 0.5 mg-N/L was used as an approximation of the background concentration of nitrate-nitrogen for percolating rainwater in native woodland areas. There are no other nitrogen inputs to the Dickson Ridge site other than the proposed leachfield.

- **Soil Denitrification.** Total nitrogen removal in the soil zones around and below the dispersal field was estimated to be 25 percent of the total nitrogen discharged. This value is at the higher end of estimates commonly assumed for analysis of groundwater nitrate loading. It is justified in this case based on the relatively high amount of organic matter in the soil, the thick and expansive forest litter, and heavy forest vegetation within and extending downhill of the leachfield area. The analysis of nitrogen losses in the soil is conservative (safe) as it does not include any explicit factor for nutrient uptake by the forest vegetation, which is likely to be considerable.

- **Deep Percolation (Recharge).** Deep percolation was estimated through completion of a month-by-month water balance analysis (see attached worksheet, **Table F-1**), which accounts for rainfall, runoff (which is nil for this site), evapotranspiration losses, and soil moisture storage. Deep percolation volumes were calculated as the net result of direct rainfall minus actual evapotranspiration and soil storage times the recharge area. Average monthly rainfall data were obtained from historical information for the Woodacre Fire Station. Estimates of average evapotranspiration for the was from published guidelines provided by the California Irrigation Management Information System (CIMIS). The actual monthly evapotranspiration was estimated by using a 0.5 Plant Factor (PF) multiplier, which is applicable for heavily woodland site conditions. The average annual deep percolation was estimated to be 27.8 inches, which equates to 60.24 acre-feet for the 26-acre site.

RESULTS

Using the above assumptions and rainfall-recharge amounts from the water balance analysis, the results of the nitrate loading analysis are summarized below; spreadsheet calculations are provided in attached **Tables F-1** and **F-2**. The analysis shows the following:

- For dispersal of primary-septic tank effluent (Alternative 3): (a) a community leachfield for 100 connections or less would comply with Marin County 10 mg-N/L criterion for new wastewater systems in areas served by public water supply; (b) a community leachfield for 150 connections would exceed the resultant 10 mg-N/L criterion; however, as a repair/replacement system it would be substantial improvement over existing nitrate loading effects from marginal septic systems in Woodacre.

- For dispersal of secondary-treated wastewater (Alternative 4), a minimum effluent treatment level of 30 mg-N/L or better would ensure resultant percolating groundwater beneath the site does not exceed 10 mg-N/L.

Nitrate Loading Analysis Results Summary

Project Alternative	Number of Residences	Average Wastewater Flow (gpd)	Level of Treatment	Effluent Nitrogen Concentration (mg/L as N)	Resultant Groundwater Nitrate Concentration* (mg/L as N)
3	100	12,500	Septic Tank Effluent	60	8.89
	150	18,750	Septic Tank Effluent	60	12.00
4	150	18,750	Secondary Treatment w/N Removal	20	4.25
				25	5.22
				30	6.19
	200	25,000	Secondary Treatment w/N Removal	20	5.10
				25	6.29
				30	7.48
	250	31,250	Secondary Treatment w/N Removal	20	5.83
				25	7.21
				30	8.59

*Criterion per Marin County onsite wastewater regulations is 10 mg/L max in areas served by public water system

Table F-1. Water Balance-Recharge Analysis - Dickson Ridge Leachfield Site, Woodacre
Average Rainfall Conditions

Month	1	2	3	4	5	6	7	Net Recharge Volume
	Ave Precip. (in/month)	Average Runoff Volume (fraction)	Available Precip. (in/month)	Potential ETo (in/month)	Actual ET (in/month)	Soil Storage (in/month)	Net Rainfall Recharge (in/month)	ac-ft
Oct	2.05	0.00	2.05	3.41	1.71	0.35	0.00	0.00
Nov	5.13	0.00	5.13	2.40	1.20	1.81	2.12	4.59
Dec	8.01	0.00	8.01	1.86	0.93	0.00	7.08	15.34
Jan	9.39	0.00	9.39	1.86	0.93	0.00	8.46	18.33
Feb	7.53	0.00	7.53	2.24	1.12	0.00	6.41	13.89
Mar	5.29	0.00	5.29	3.41	1.71	0.00	3.59	7.77
Apr	2.40	0.00	2.40	4.50	2.25	0.00	0.15	0.33
May	1.03	0.00	1.03	5.27	2.64	0.00	0.00	0.00
Jun	0.28	0.00	0.28	5.70	2.85	0.00	0.00	0.00
Jul	0.05	0.00	0.05	5.89	2.95	0.00	0.00	0.00
Aug	0.09	0.00	0.09	5.58	2.79	0.00	0.00	0.00
Sep	0.39	0.00	0.39	4.50	2.25	0.00	0.00	0.00
Total	**41.64**		**41.64**	**46.62**	**23.31**	**2.16**	**27.81**	**60.24**

Notes:

1.Recharge Area, ac 26

2. Ave monthly precip for Woodacre Fire Station

3. Reference ETo obtained from CIMIS for Zone 4, for Mountains North of San Francisco

4 .Site runoff nil based on heavy forest litter, field inspection

5. Actual ET adjusted based on site specific landscape/plant cover factor (fractional multiplier); select PF of 0.5 for trees, shrubs groundcover, woody plants
https://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/SLIDE__Simplified_Irrigation_Demand_Estimation/

6. Soil moisture storage up to max of 2.16" (24"at 0.09 holding capacity, per Soil Survey for Dipsea Soils); provides month-to-month carryover

7. Net rainfall recharge equal to Available Precip (3) minus Actual ET (5); negative values set equal to zero

Table D-2. Dickson Ridge, Woodacre Leachfield Site

Nitrate-N Loading Calculation - Annual Water-Chemical Mass Balance

Project Alternative	Wastewater Treatment Level	# of Connections	Wastewater				Rainfall Recharge, R	Background Nitrogen, N_B	Resultant GW Nitrogen, N_C
			Flow, W		Effluent Total N_w	Denitrification, d			
			gpd	ac-ft/yr	mg-N/L	(fraction)	ac-ft	mg-N/L	mg-N/L
3	Septic Tank Effluent	100	12,500	14.00	60	0.25	60.24	0.5	**8.89**
3	Septic Tank Effluent	150	18,750	21.00	60	0.25	60.24	0.5	**12.00**
4	Secondary Treatment	150	18,750	21.00	20	0.25	60.24	0.5	**4.25**
			18,750	21.00	25	0.25	60.24	0.5	**5.22**
			18,750	21.00	30	0.25	60.24	0.5	**6.19**
4	Secondary Treatment	200	25,000	28.00	20	0.25	60.24	0.5	**5.10**
			25,000	28.00	25	0.25	60.24	0.5	**6.29**
			25,000	28.00	30	0.25	60.24	0.5	**7.48**
4	Secondary Treatment	250	31,250	35.00	20	0.25	60.24	0.5	**5.83**
			31,250	35.00	25	0.25	60.24	0.5	**7.21**
			31,250	35.00	30	0.25	60.24	0.5	**8.59**

Assumptions:

1. Average Daily Wastewater Flow from Single Famility Residence: 125 - annual average = 2.5 per residence at 50 gpd/person
2. Service Connections: 100 through 250
3. Septic tank effluent nitrogen concentration varies from 60 to 65 mg-N/L .
4. Secondary treatment effluent 100
5. Denitrification and uptake estimated range of 25% for gravelly loam to clay loam, dense forest vegetation, 300-ft lateral down-slope buffer run-out/flow path
6. Rainfall recharge from monthly water balance analysis attached.
7. Background nitrate-nitrogen estimate ND to 0.5 mg-N/L, from native woodland

Calculation:

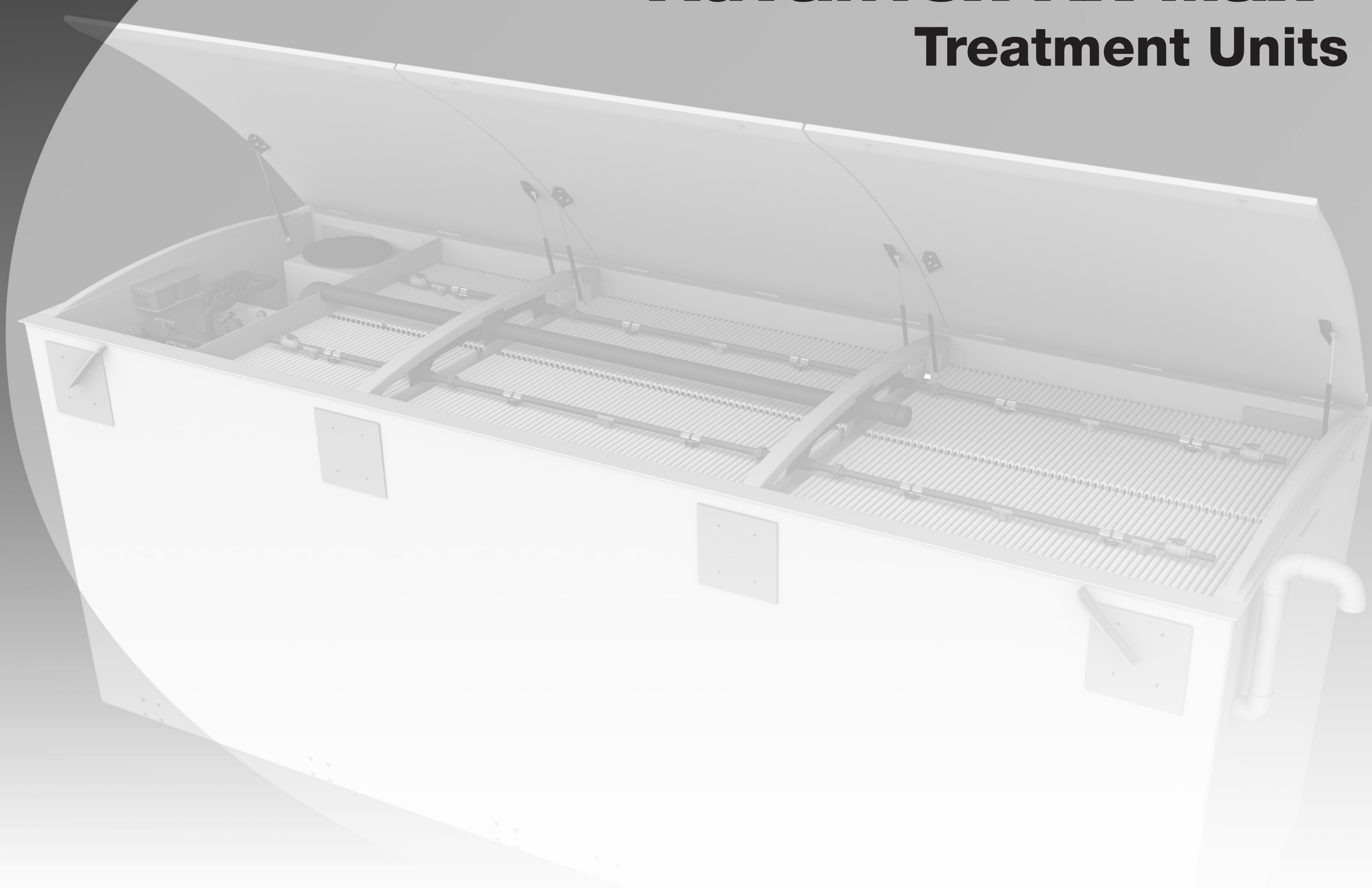
Resultant Nc = $((W)*(N_w)*(1-d) + (R*N_B))/(W+R)$

Appendix G

Wastewater Manufacturer Information

Installation Manual

AdvanTex® AX-Max™ Treatment Units



Orenco® WATER

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How to Use This Manual

This manual contains an Installation Overview and a set of Installation Steps.

- **Installation Overview** — This is a simple overview of the installation steps. It is a reference only; complete instructions are found in the installation steps that follow.
- **Installation Steps** — These provide general instructions for each installation step, along with references to installation documents for specific components. Many Orenco products come with installation instructions. All of these instructions are also provided in hard-copy form in our Orenco Installer Binder. Contact your dealer or Orenco for a copy of the binder, or find individual instructions online in the Orenco Document Library at www.orenco.com.

You will find *IMPORTANT information, Key Points*, and *Notes* in this manual, marked with easy-to-see visuals:

IMPORTANT — These point out potential hazards to equipment or people during and after the installation.

Key Points — These are critical for a quality installation and are necessary for your installation to be successful.

Notes — These cover useful information and tips that can help make your installation simpler or easier. They may also provide information on variations in components or methods.

All product and performance assertions are based on proper design, installation, operation, and maintenance according to Orenco's current published documentation.

Before You Begin

Before you begin the installation, read this manual and any documents referenced in it. Also, be sure that the instructions for these products are the most current ones available. Please note that ***you must perform the installation according to the current manual or the AdvanTex Treatment Systems Limited Warranty will be void.*** You can make sure your instructions are current by checking our online Document Library at www.orenco.com. You'll save time and money on installation day, and you'll get fewer call-backs.

This manual provides basic information for installing AdvanTex AX-Max treatment units in-ground. These instructions do not replace training or engineering plans.

Before beginning the installation, schedule a pre-construction meeting with the project engineer, electrician, operator, inspector/regulator, and your Orenco representative. Any inconsistencies in the plans, specifications, or regulatory issues identified during the pre-construction meeting should be completely addressed prior to installation. If there are differences between your engineering plans and the instructions in this manual, contact your project engineer.

IMPORTANT

- *DO NOT plumb the backwash discharge from a salt-type water softener into an AX-Max unit or preceding primary treatment tankage.*
- *Failure to follow the instructions in this manual will void the system's warranty.*
- *Take necessary precautions to avoid falling into the AX-Max units.*
- *Properly secure all access lids after the work is complete.*

Key Points

- Inspect your order for completeness and inspect each component for shipping damage. If any part of the order is incomplete or damaged, contact your dealer or Orenco.
- Contact your engineer if you have questions about your installation.
- All tankage, components, and plumbing used in conjunction with an AX-Max treatment unit must be installed properly according to their manufacturer's instructions.
- All tankage, components, and plumbing used in conjunction with the installation of an AX-Max treatment unit must be watertight.
- Make sure these instructions and the items supplied comply with your state and local regulations.
- If you are not an authorized AdvanTex Installer, contact your local dealer for training and authorization before installing this system.
- Improper installation may cause difficulties in system performance, operation, and maintenance issues.

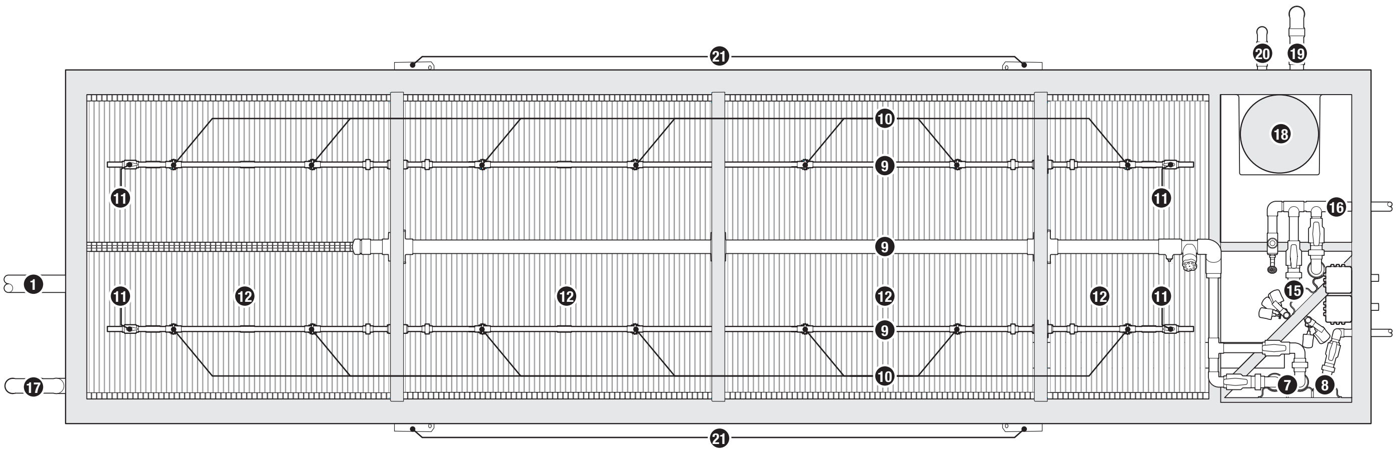
Note *All pipe diameters provided are US nominal IPS pipe sizes. If you are using metric pipe, you may need adapters to connect to the US fittings supplied with AdvanTex Treatment Systems.*

Standard Unit Components

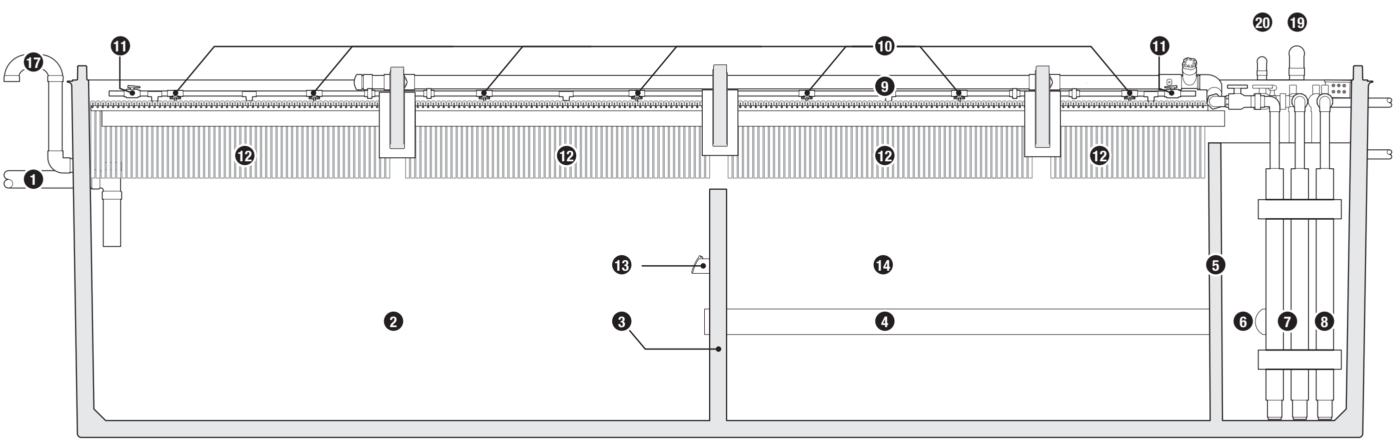
Example AdvanTex AX-Max Treatment Unit

AX-Max units are highly customizable. The configuration and components shown in this diagram are not intended to match the specific units used in your installation.

1. AX-Max inlet
2. Recirc-blend chamber
3. Tank baffle
4. Recirc-transfer line
5. Recirc-pump chamber baffle
6. Recirc-pump chamber
7. Recirc pumping assembly
8. Pre-anoxic return pumping assembly
9. Distribution manifold
10. Spray nozzles
11. Lateral ball valves
12. AdvanTex textile media
13. Recirc-return valve
14. Recirc-filtrate chamber
15. Discharge pumping assembly
16. Discharge outlet
17. Vent inlet
18. Vent fan assembly
19. Vent outlet
20. Vent motor air exchange
21. Lifting bracket



Example AX-Max Treatment Unit (top view, without lids)



Example AX-Max Treatment Unit (side cutaway view, without lids)

Installation Overview

Step 1. Review and compare the plan set to the actual site.

Step 2. Perform the excavation(s) for the AX-Max unit(s) to the depths shown on the plan set.

Step 3. Prepare the pads for the AX-Max unit(s).

Step 4. Set the AX-Max unit(s) into position.

Step 5. Place antibuoyancy measures on the AX-Max unit(s), if necessary.

Step 6. Plumb, test watertightness, and backfill the unit(s) in stages until you reach the grade specified on the plan set.

Step 7. Mount the control panel, route conduit and wiring, and connect the panel's inputs and outputs.

Step 8. Prep the AX-Max unit(s) for start-up.

Installation Steps

Step 1. Review and Compare Plan Set

Review the plan set and compare it with the actual physical site.

- Make sure there are no obstructions on the site that could interfere with the installation.
- Check that all locations and elevations match the plan set.
- Discuss any differences between the plan set, the site, and these instructions with the engineer before continuing.

Key Points

- Follow the plan set for specific spacing distances between AX-Max units, as well as between AX-Max units and other buried components. Contact your dealer for more information.
- See Table 1 for depth and spacing recommendations.
- For reasonable service access, Orenco strongly recommends 24-36in (610-914mm) clearance between final grade and the underside of the unit's lid. See your plan set for specific burial or berming depths.
- If the transport line from primary tankage or the sewer inlet uses gravity discharge, maintain a minimum slope of 1⁄8in per foot (10mm per meter or 1%) in the transport piping from the primary tankage.

Step 2. Perform Excavations

Note *For units installed above grade and then bermed, skip this step and go to Step 3.*

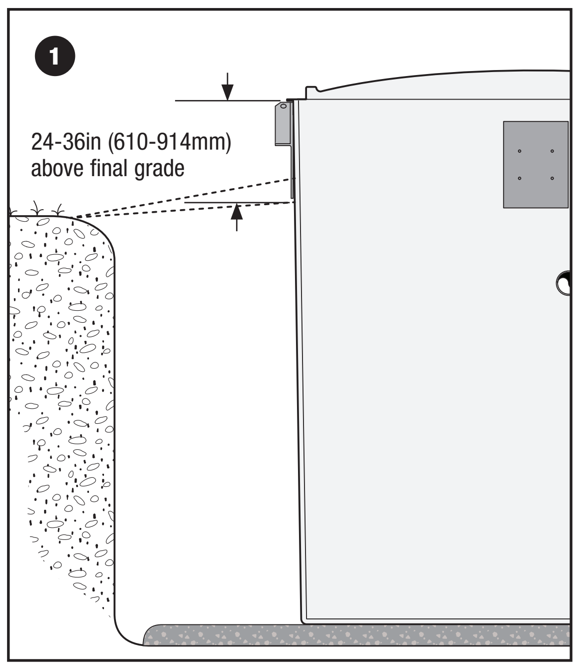
Perform the excavations required for the AX-Max unit(s).

- Mark the site(s) for the unit(s) and plumbing runs.
- Make the excavation(s) to the depth listed in the plans.
- If necessary, install shoring. Consult the engineer and applicable regulations for shoring requirements.
- If specified, excavate and prep French drains or other drainage systems.

Table 1. Recommended Spacing for Units Equipped with Antibuoyancy Measures

Burial Depth,* ft (mm)	Required Spacing, ft (mm)
5.5 (1680)	8 (2440)
6.5 (1980)	10 (3050)
7.5 (2290)	12 (3660)

*Burial depths are measured from the bottom of the unit.



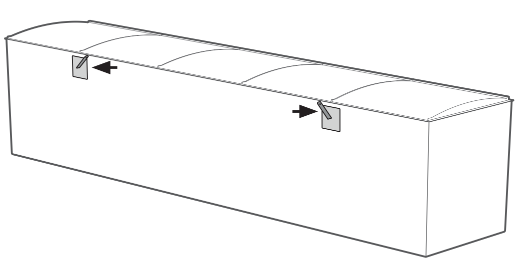
Installation Steps

3b

Lay a smooth, level pad for each unit. (Compacted aggregate pad shown.)

4b

Lifting bracket locations (two per side, four total)



4d

Lift and move the unit into place over the pad.

Step 3. Prepare AX-Max Unit Pad(s)

Step 3a: Make sure the bottom of the excavation or the pad site for each AX-Max unit is level and free of debris, rocks, and sharp objects.

- The base has to be stable and uniform to ensure equal bearing across the tank bottom.

Step 3b: Lay a level, compacted bedding of ≤¾in (19mm) aggregate, pea gravel, or approved granule overlying a firm, uniform base.

- Compact the bed to 95% compaction.
- Lay the pad at least 7.5ft (2.3m) wide and at least as long as the unit.

Key Points

- Completely level pads are critical for correct installation.
- If the base soil is unstable (peat, quicksand, muck, soft or highly expansive clay, etc.), overexcavate the site depth and set a firm, 6in (150mm) compacted pad of ≤½in to ≤¾in (13 to 19mm) aggregate.
- For installing in-ground units in extremely unstable soil, a concrete pad may be required to stabilize the bottom of the excavation. Contact the engineer with questions about soil stability.

Step 4. Set AX-Max Unit(s)

IMPORTANT

- *ALWAYS bolt the lids before lifting, moving, or backfilling the AX-Max unit!*
- *Know the weight of the specific unit and use the proper lifting equipment.*
- *AX-Max units vary in weight up to more than 12,000lbs (5443kg). If you are unsure of the unit's weight, contact Orenco before attempting to lift it.*

Key Point When installing multiple units in the same system, confirm the location and direction of each unit before off-loading and placing it.

Step 4a: Position the transport vehicle and lifting equipment as close to the pad as possible.

Step 4b: Attach the provided lifting cables to the four lifting brackets on the unit and raise the lifting equipment until all of the cables are tight.

IMPORTANT *Make sure the cables are properly attached!*

Step 4c: If antiflotation brackets are included with the unit, attach them to the unit's base with the supplied hardware.

Step 4d: Lift and move the AX-Max unit into position over the pad.

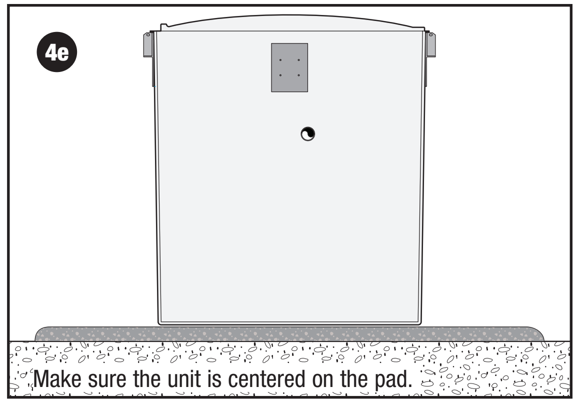
IMPORTANT *Keep nonessential personnel clear when placing the AX-Max units!*

Installation Steps

Step 4. Set AX-Max Unit(s), cont.

Step 4e: Lower the unit onto the pad, making sure that the unit is centered.

Key Point The underside of the unit's lid requires 24-30in (610-760mm) clearance above final grade.



Step 5. Construct Antibuoyancy Measures (If Needed)

Key Points

- The standard method for constructing antibuoyancy measures is described below. For other methods, contact your dealer or Orenco.
- Contact the project engineer if you are unsure about the need for antibuoyancy measures.

Step 5a: Build forms 12in high × 20in wide (305mm × 508mm) along the full length of both long sides of the unit(s).

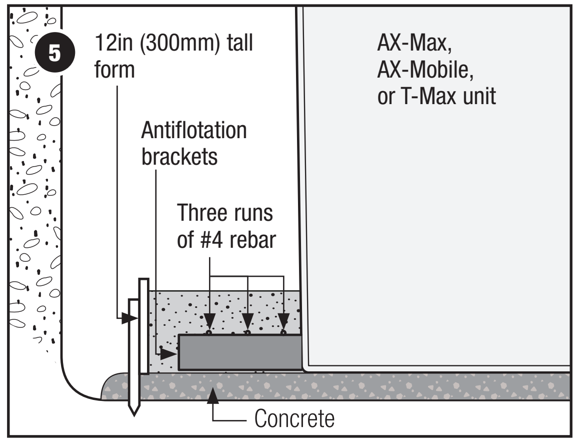
- The concrete has to cover the rebar by a minimum of 1.5in (40mm) after it is poured and level.

Step 5b: Place three evenly spaced #4 rebar runs on top of the antiflotation brackets, along the unit's entire length on both sides.

- Tack weld or wire-tie the rebar pieces in place on the brackets.

Step 5c: Pour concrete into the forms.

Step 5d: Wait for the concrete to set before backfilling.



Step 6. Plumb and Backfill AX-Max Unit(s)

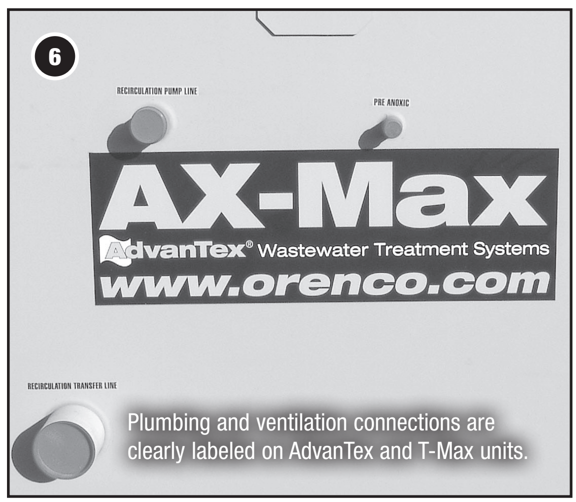
Key Points

- Keep all AX-Max lids bolted down during backfilling, unless you are filling the unit(s) with water.
- Only one lid on an AX-Max unit can be unbolted at any time during backfilling and adding water.

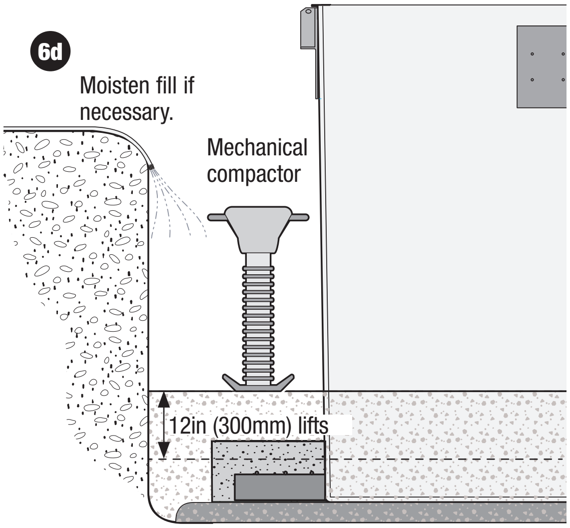
Step 6a: Use the plan set to identify the location of all transport lines and ventilation connections between the AX-Max unit(s) and other treatment components, tankage, sewer lines, and dispersal.

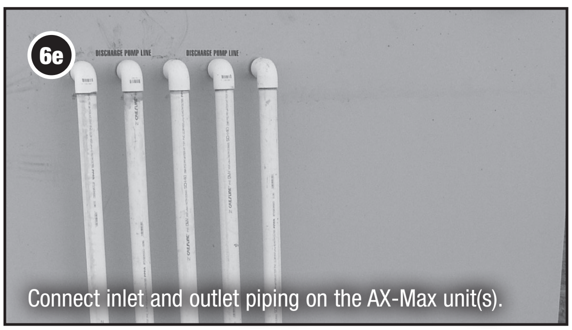
Step 6b: Connect any recirculation transfer, recirculation return, and filtrate transfer lines.

- Support the transport lines to prevent sagging.
- If there are no recirculation transfer, recirculation return, or filtrate transfer lines, go to Step 6e.

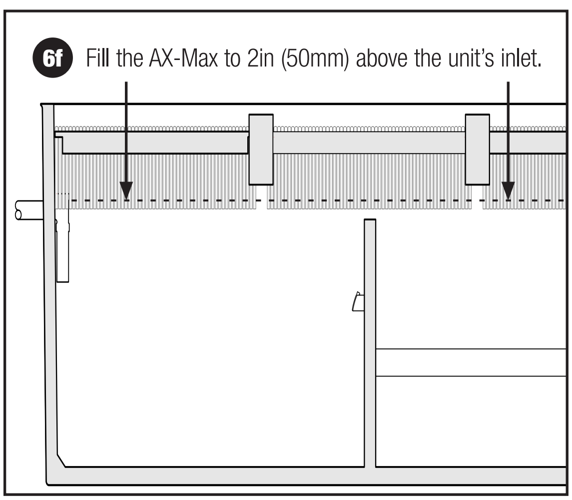


Installation Steps





Connect inlet and outlet piping on the AX-Max unit(s).



Step 6. Plumb and Backfill AX-Max Unit(s), cont.

Step 6c: Fill each AX-Max unit with water to 6in (150mm) above the recirc transfer, recirc return, and filtrate transfer connections to test for watertightness.

- Wait 10 minutes and then check for leaks around the penetrations and lines, as well as for changes in the liquid level inside the AX-Max unit(s).
- Repair any leaks in the lines and connections.
- Contact Orenco for any leakage around plumbing penetrations in the AX-Max unit(s) or if the liquid level inside the unit(s) decreases.

Step 6d: Backfill around the AX-Max unit(s) to 2in (50mm) above the recirc transfer, recirc return, and filtrate transfer lines.

- Lay a level, 95% compacted bed of ≤¾in (19mm) aggregate, pea gravel, or approved granule for transfer lines.
- Backfill in 12in (300mm) lifts – don't damage the lines.
- Use a mechanical compactor to compact each lift.
- If necessary, moisten the backfill material with water to help compaction.

Step 6e: Connect the inlet and outlet piping to the AX-Max unit(s).

- Support the inlet and outlet piping to prevent sagging.

Step 6f: Fill each AX-Max unit with water to 2in (50mm) above the inlet to test for watertightness.

IMPORTANT *NEVER submerge electrical conduit penetrations or junction boxes inside an AX-Max unit!*

- Do not fill the unit more than 2in (50mm) above the inlet.
- Wait 10 minutes and then check for leaks around the penetrations and lines, as well as for changes in the liquid level inside the AX-Max unit(s).
- Repair any leaks in the lines and connections.
- Contact Orenco for any leakage around plumbing penetrations in the AX-max unit(s) or for changes in the liquid level inside the unit(s).

Step 6g: Backfill around the AX-Max unit(s) to the level listed on the plan set.

- Lay a level, 95% compacted bed of ≤¾in (19mm) aggregate, pea gravel, or approved granule for inlet and outlet piping.
- Backfill in 12in (300mm) lifts.
- Use a mechanical compactor to compact each lift.
- If necessary, moisten the backfill material with water to help compaction.

Installation Steps

Step 6. Plumb and Backfill AX-Max Unit(s), cont.

Key Points

- Don't alter the slope of lines or damage the lines during backfilling.
- The underside of the unit's lid requires 24-30in (610-762mm) clearance above final grade.
- Do not use native material to backfill if it is very soft or highly expansive clay or if it contains debris, large (>¾in or 19mm) rocks, sharp rocks, peat, or muck. In these cases, use ≤¾in (≤19mm) crushed stone as fill material. This material should be washed and free of debris.
  – In noncohesive soils* with high seasonal water tables, use ¾in crushed rock as the backfill material.
  – Do not backfill with sand.
- Be sure that the final grade slopes away from the unit(s).

* As described in OSHA Standards (29 CFR, Part 1926, Subpart P, Appendix A), noncohesive soils or granular soils include gravel, sand, or silt with little or no clay content. Granular soil cannot be molded when moist and crumbles easily when dry. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay. Cohesive soil does not crumble, can be excavated with vertical sideslopes, is hard to break up when dry, and when moist, can be rolled into threads without crumbling. For example, if at least a 2in (50mm) length of 1/8in (3mm) thread can be held on one end without tearing, the soil is cohesive.

Step 7. Mount and Connect Control Panel

Note *Installation instructions, schematics, and wiring diagrams that are specific to the panel and float switch configuration are included with each panel. If any of these is missing, contact your dealer for a replacement.*

Step 7a: Mount the control panel using the instructions included with it.

IMPORTANT *DO NOT mount the control panel on an exterior wall of a residential building or living space other than a garage or shop wall! The motor contactors make a sound while engaging and disengaging that can be disruptive to occupants.*

Key Points

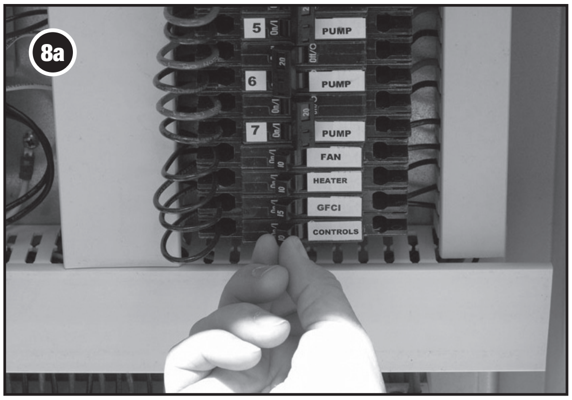
- Follow all applicable regulations for placement of the control panel.
- Mount the panel in a service-friendly location.
- Protect panels from direct sunlight, if possible, by installing them under protective coverings, mounted on weather-resistant material and supports.
  – Ultraviolet light can degrade the surface of the panel over time.
  – Constructing shade for the panel helps avoid excessive temperatures.

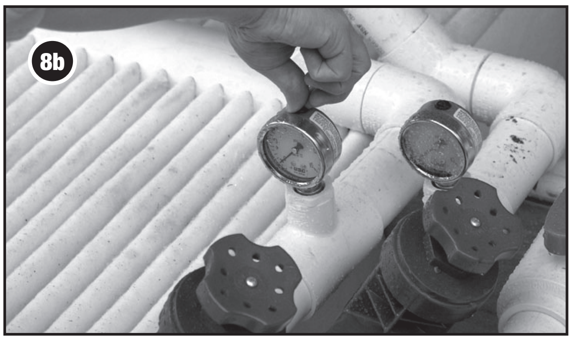
Step 7b: Route and install any necessary electrical conduit.

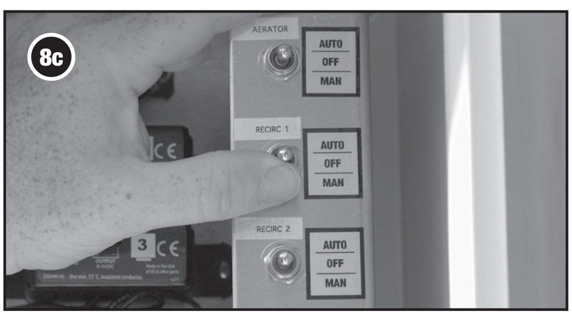
Control panel mounted on external wall.

Control panel mounted on backing panel and posts.

Installation Steps







Step 7. Mount and Connect Control Panel, cont.

Step 7c: Route all system-related electrical and telecom wires into the control panel and make connections as shown in the system's wiring diagram.

- One or more incoming power circuits may be required for the control panel, depending upon the number of pumps and applicable codes.
- Phone, Ethernet, or cellular modem wiring is required for remote access (in TCOM remote telemetry panels).

Key Points

- This step should be performed by a licensed and qualified electrician.
- Follow all applicable regulations and electric codes.
- Use waterproof wire connectors to avoid electrical shorts and other issues.
- Be sure to seal the conduit at the control panel and at the splice box with UL-listed sealing foam, putty, silicone sealant, or an Orenco seal kit.

Step 7d: Connect electrical power to the control panel.

- This step should be performed by a licensed and qualified electrician.

Step 8. Prep AX-Max Unit(s) for Start-Up

Make sure that the AdvanTex unit(s) and all components are functioning properly.

- See AIM-OM-ATX-4, *AdvanTex O&M Manual, AX-Max and AX-Mobile Treatment Systems* for specific information covering the start-up of these treatment systems.

IMPORTANT *Before testing pumps in AX-Max units, be sure the unit is filled with enough water to avoid damaging the pumps.*

Step 8a: Switch the control panel circuit breakers to "ON."

- Check the wiring diagram in the control panel for circuit breaker locations.

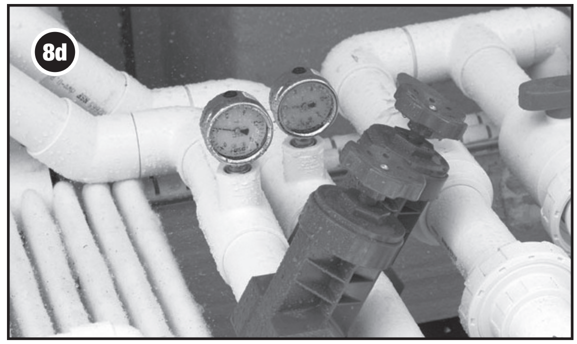
Step 8b: Equalize the pressure on the pressure gauges in the AX-Max unit(s).

Step 8c: Flush the unit's laterals in the AX-Max unit(s).

- Turn the laterals to point the spray nozzle turbines up and away from the textile.
- Open the outlet valves on the ends of the laterals.
- Open the manifold valve.
- Toggle the recirc pump switches to "MAN."
- Allow the pumps to flush debris out of the pod's manifold and laterals.
- Toggle the recirc pump switches to "OFF."
- Close the outlet valves on the ends of the laterals.
- Turn all laterals so the spray nozzle turbines are pointed down.

Installation Steps

Step 8. Prep AX-Max Unit(s) for Start-Up, cont.



Step 8d: Check the nozzle spray patterns in the AX-Max unit(s).

- Toggle the recirc pump switches to "MAN."
- Pressurize the manifold and laterals to 3.5psi (24.1kPa).
- Check the nozzles for square spray patterns onto the splash guards.
- Adjust the manifold pressure for good spray patterns, if needed.
- Toggle the switches to "OFF" when finished.

Step 8e: Make sure the following components are functional and operating properly in each AX-Max unit equipped with them:

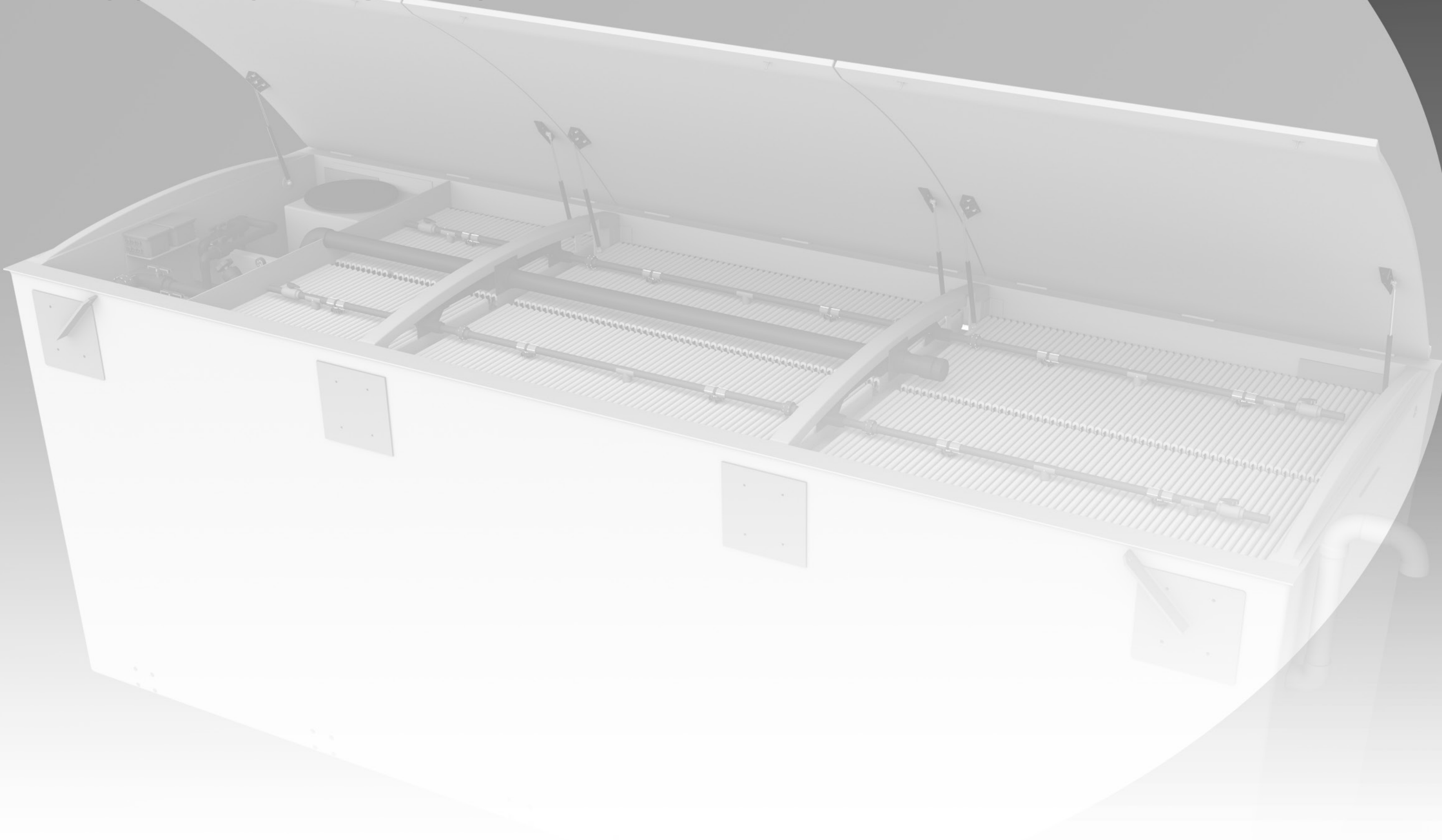
- **Recirc float switches**
  – Toggle the pump control switches to "AUTO."
  – Check the functioning of the recirc pump float switches by lifting the low-level, mid-level, and high-level switches in turn and verifying their signals in the control panel.
- **Discharge pump(s) (if applicable)**
  If the unit is equipped with discharge pump(s), verify that the discharge pumps and float switches (if applicable) are operating correctly.
  – **For pumps with timed-dose controls**
  Toggle the discharge pump switches to "MAN" and verify that the pumps run.
  – **For pumps with demand-dose controls**
  Toggle the pump control switches to "AUTO" and check the functioning of the float switches by lifting the low-level, mid-level, and high-level float switches in turn and verifying their signals in the control panel.
- **Ventilation system**
  Verify that the ventilation fan is operational and that there is air flow at the vent inlet and at the vent exhaust.
- **Control panel touch screen (if applicable)**
  Verify that the touch screen is operational.

Step 8f: After making sure that the AX-Max unit(s) are functional and operating properly, close and secure all unit lids.

Step 8g: Schedule a system start-up with the project engineer, AdvanTex dealer, and system operator.

Installation Manual

AdvanTex® AX-Max™ Treatment Units



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CASE STUDY

An Affordable Wastewater Treatment Solution for Municipalities and Communities

PINEBROOK, NEW YORK

Problem In 2014, the community of Pinebrook in Hyde Park, New York, began having trouble with its wastewater treatment plant, a rotating biological contactor (RBC). Discharge from the plant was contaminating the Maritje Kill (a tributary of the Hudson River), and sewer lines backed up into the community building. By the end of the year, a full evaluation of the plant concluded that the RBC had significant performance, structural, operational, and safety deficiencies and was not worth salvaging.

Solution The Dutchess County Water and Wastewater Authority commissioned a Preliminary Engineering Report to recommend alternatives for replacing the failing RBC. Three options were evaluated: a brand-new RBC, a membrane bioreactor, and a packed-bed filtration system. Because of its many advantages – including low life-cycle costs[1], consistently high-quality effluent, minimal operation & maintenance requirements, and a small footprint – an AdvanTex (packed-bed filter) Wastewater Treatment System was recommended.

Community Wastewater Treatment Plant Needs Replacement

An AdvanTex® AX-Max™ Wastewater Treatment System – with its low life-cycle costs and small footprint – was chosen as the best replacement for a failing treatment plant in the community of Pinebrook. (Photo courtesy of Julie Barown.)

Development of the Pinebrook community in Hyde Park, New York, began in the 1980's. Gravity sewer lines delivered wastewater to a rotating biological contactor (RBC) at the community's wastewater treatment plant. As the community grew, it added additional sections of gravity sewer collection lines through 2009. At that time, ownership and management of the sewer and the treatment plant was turned over to the Town of Hyde Park.

Municipal and Community Market

Project Overview

PINEBROOK, HYDE PARK, NEW YORK

Design Parameters
- 132 residential connections
- 15,000 gpd (57 m^3/day) average flow
- 60,000 gpd (227 m^3/day) maximum flow

NPDES Permit Limits
- 5 mg/L $cBOD_5$
- 10 mg/L TSS
- 0.93 mg/L NH_3-N (summer)
- 1.3 mg/L NH_3-N (winter)

Effluent Quality*
- 2 mg/L $cBOD_5$
- 0.5 mg/L TSS
- 0.24 mg/L NH_3-N

Start-Up Date
- February 2019

Project Cost
- $2.24 million

Funding Sources
- New York Department of State (grant)
- Environmental Facilities Corporation (NY):
  - Water Infrastructure Improvement Act (grant)
  - Clean Water State Revolving Fund (loan)

Collection System
- Gravity sewer

Primary Treatment
- Two 15,000-gallon (57-m^3) tanks

** Samples collected and analyzed by a third party between 7 May 2019 and 7 October 2019.*

sidebar continued on back page

PINEBROOK, NEW YORK

Between November and April, six AdvanTex AX-Max units were installed to replace Pinebrook's failed rotating biological contactor (RBC). The final photo on the right shows that the RBC and the building once housing it have been removed. *(Photos courtesy of the Dutchess County Water and Wastewater Authority.)*

By 2013, there were 450 people living in the Pinebrook community. Unfortunately, environmental issues became evident the next year when the RBC plant was no longer able to meet its permit limits, and wastewater from the plant was discovered to have contaminated the nearby Maritje Kill, a tributary of the Hudson River. The situation worsened when sewage backed up into the community building.

A complete evaluation of the plant concluded that, due to major performance, structural, operational, and safety issues, the RBC would need to be replaced.

In 2015, the Dutchess County Water and Wastewater Authority (DCWWA) accepted ownership and responsibility for the plant from the Town of Hyde Park. The DCWWA commissioned a Preliminary Engineer's Report to recommend alternatives for replacement. A major challenge during the replacement process would be the community's need for the existing RBC to remain in operation while the new treatment site was under construction. In addition, the reporting engineer had to consider these challenges posed by the site itself:

- Very small, intermittent receiving stream for discharge
- Existing plant site of less than an acre
- Limited open space outside of existing plant footprint
- Proximity to residences of about 100 ft (30 m)

A replacement system would also need to fulfill these requirements:

- Able to meet strict discharge permit limits for ammonia, $cBOD_5$, and TSS
- Simple and safe for a part-time (1 hour/day) operator
- Low up-front capital costs
- Low life-cycle costs, including operation and maintenance (O&M)
- Small footprint
- Minimal community impact (sight, sound, and odor)
- Reliable operation

Engineering Report Recommends Biofiltration

The report evaluated three options: a brand-new RBC, a membrane bioreactor, and a biofiltration (packed-bed) system. Replacing the worn-out RBC with a new one may have seemed like an obvious choice, but the engineering report found that a new RBC would not eliminate the noise and odor that nearby residents had been complaining about regarding the existing RBC. Pinebrook is a development that's completely built-out, with no other property to locate the wastewater treatment plant on other than the current site of less than one acre. And the site where the plant is located is in a well-populated, quiet residential area.

Most importantly, of the three alternatives being evaluated, an RBC would have the highest capital, life-cycle, and sludge-removal costs, not to mention concerns for operator safety. An RBC would also require regular motor maintenance and the periodic, significant expense of motor, shaft, and media replacement.

While the second option of installing a membrane bioreactor (MBR) would mean a much smaller footprint and more moderate life-cycle costs, the engineering report voiced concerns over the cost of membrane replacement, electricity, sludge removal, and steel tank maintenance and replacement. Plus, an MBR would need to be installed inside a tall, obtrusive building, both for weather protection and to minimize odor, sound, and vibration. Other concerns included repairability, operability, operator safety, and the availability of a higher-level operator with the expertise to handle an MBR.

The third option evaluated was biofiltration, or the use of a packed-bed filter (PBF). A PBF uses a passive, attached-growth treatment process that is inherently stable and highly reliable. Microbes attach to and grow on the treatment media, which hangs in sheets in aligned rows. The media isn't submerged, so the aerobic microbes operate in unsaturated conditions. They form a thin film on the media sheets and extract and digest soluble organic matter from the wastewater, which is applied over the media in small doses.

Weighing all factors, the engineering report recommended a biofiltration system. PBF filtrate is typically low in biochemical oxygen demand, suspended solids, and concentrations of pathogenic organisms. And a PBF would meet all of the project requirements, as well as offer the following advantages:

- High-quality effluent that outperforms permit standards
- Minimal O&M requirements (only periodic inspections needed, not constant oversight)
- Lowest life-cycle cost[2] of all three options
- Low energy use[3], due to intermittent dosing from small-horsepower pumps
- Optional in-ground installation
- Minimal odor and noise (no aeration blowers)
- A good fit for community aesthetics (not an "ugly" treatment plant)

The AX-Max uses a passive, attached-growth treatment process that is inherently stable and has minimal operation and maintenance requirements. The Max also minimizes noise and odor, making it "neighborhood-friendly." (Photo courtesy of the Dutchess County Water and Wastewater Authority.)

An Affordable Wastewater Treatment Solution for Municipalities and Communities

PINEBROOK, NEW YORK

Fast-Tracked Construction

Because Pinebrook's existing RBC treatment system was in imminent danger of failure, construction on the new system needed to be fast-tracked. To accomplish this, the DCWWA chose to pre-purchase the main treatment equipment, which allowed the system to be manufactured while bidding for the installation was taking place, saving more than six months on the project schedule. Purchasing the equipment up front also saved money by eliminating the contractor markup.

The completed project came in significantly under budget, primarily because the original cost estimate had been based on the idea of replacing the failing RBC with a new one. Switching to an AdvanTex Wastewater Treatment System offered the community substantial savings.

Another advantage was the fact that the RBC could remain in service while the AdvanTex units were being installed. Jonathan Churins, Project Facilitator with DCWWA said, "The modular nature of the Orenco system allowed the new plant to be constructed around the old, enabling dual operation and a smooth transition."

The AdvanTex facility has a footprint of fewer than 10,000 ft^2 (929 m^2). That includes tanks for primary and pre-anoxic treatment, plus six AdvanTex AX-Max treatment units. There's also a building that houses a TCOM™ control panel from Orenco Controls™, an automatic alkalinity feed system, magnetic flow meters, and a UV disinfection unit.

Neighborhoods like Pinebrook have historically faced enormous challenges when constructing and maintaining wastewater systems. These communities typically have limited experience with construction or operation of wastewater infrastructure, and their systems are frequently responsible for environmental violations related to wastewater treatment and disposal.

With its low maintenance and energy[4] requirements, Orenco's reliable AdvanTex technology has proven its value over and over again by helping engineers find answers for neighborhoods and communities that need affordable wastewater solutions.

[1] Rennia Engineeering Design, PLLC, "Preliminary Engineering Report for Pine Brook Sewer District," June 13, 2016, Appendix E.

[2] Ibid.

[3] About 3.17 kWh per 1000 treated gallons. Orenco Systems, Inc., "How to Compare Power Consumption of Advanced Treatment Systems," AHO-ATX-POWER-1, 2006.

[4] Ibid.

Data used by Orenco to derive the representations and conclusions contained within this Case Study were current as of January 2020.

Municipal and Community Market

Pre-Anoxic Treatment
- Two 15,000-gallon (57-m^3) tanks

Secondary Treatment
- Stage 1: four 42-ft (12.8-meter) AdvanTex AX-Max units
- Stage 2: two 35-ft (10.7-meter) AdvanTex AX-Max units

Disinfection
- UV system

Discharge
- Surface discharge to Maritje Kill, a tributary of the Hudson River

Monitoring and Control
- Orenco Controls TCOM panel

Engineering
- Rennia Design Engineering
- Tighe & Bond

"The modular nature of the Orenco system allowed the new plant to be constructed around the old, enabling dual operation and a smooth transition."

– Jonathan Churins, Dutchess County Water and Wastewater Authority

For information about Prelos™ Sewer, AdvanTex® Wastewater Treatment, or Orenco Controls™, contact Orenco Systems®, Inc.

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INFILTRATOR® water technologies

The Quick4® High Capacity Chamber

Quick4® Series

The Quick4® High Capacity Chamber fits in a 36” wide trench and is ideal for curved or straight systems. It features the patent-pending Contour Swivel Connection™ which permits turns up to 15°, right or left. The MultiPort™ endcap allows multiple piping options and eliminates pipe fittings. The chamber’s four-foot length provides optimal installation flexibility.

Chamber Benefits:

- Advanced contouring connections swivel up to 15°, right or left
- Latching mechanism allows for quick installation
- Compact nesting provides more trench length in an equivalent stack height
- Four-foot chambers are easy to handle and install
- The Quick4 High Capacity Chamber supports wheel loads of 16,000 lbs/axle with only 12” of cover
- Certified by the International Association of Plumbing and Mechanical Officials (IAPMO)

MultiPort Endcap Benefits:

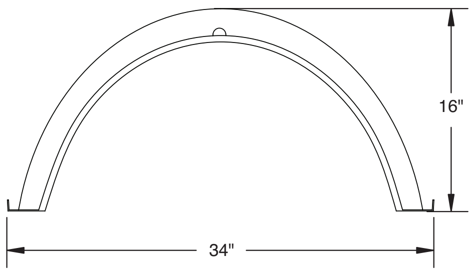
- Tear-out seals on inlet ports provide a tight fit to the pipe
- Eight molded-in inlets/outlets allow for maximum piping flexibility
- Fits on either end of the Quick4 High Capacity Chamber

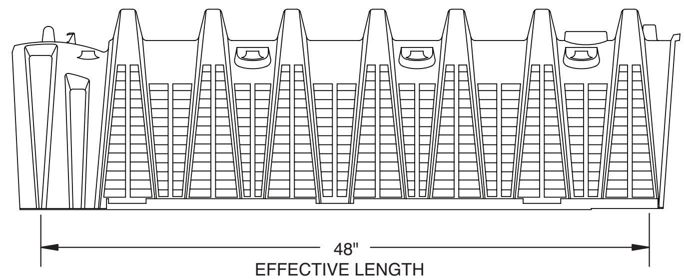
APPROVED in ________________________________

Quick4® Series

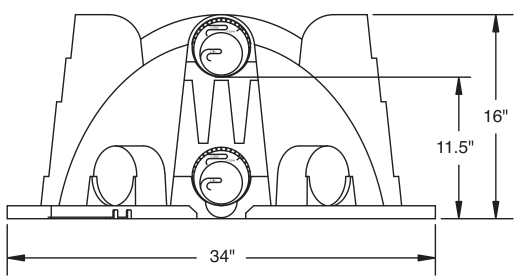
Because installations are faster with Quick4 chambers, you save on heavy equipment operation and labor.

Quick4 High Capacity Chamber

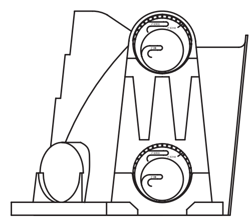




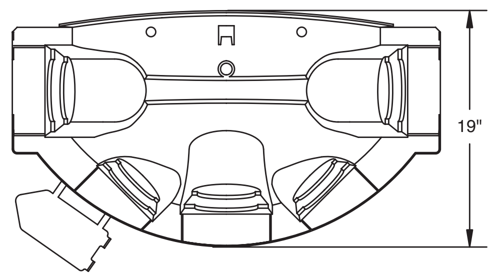
MultiPort EndCap



FRONT VIEW

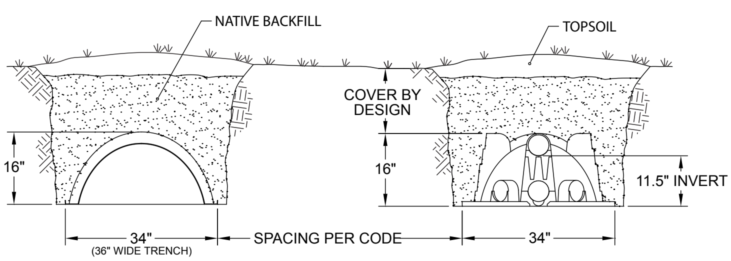


SIDE VIEW



TOP VIEW

Typical Trench View



Quick4® High Capacity Chamber Specifications	
Size	34"W x 53"L x 16"H (864 mm x 1346 mm x 406 mm)
Effective Length	48" (1219 mm)
Louver Height	12.2" (310 mm)
Storage Capacity	62 gal (235 L)
Invert Height	11.5" (292 mm)

INFILTRATOR® water technologies

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1-800-221-4436
www.infiltratorwater.com

INFILTRATOR WATER TECHNOLOGIES STANDARD LIMITED WARRANTY

(a) The structural integrity of each chamber, endcap and other accessory manufactured by Infiltrator ("Units"), when installed and operated in a leachfield of an onsite septic system in accordance with Infiltrator's instructions, is warranted to the original purchaser ("Holder") against defective materials and workmanship for one year from the date that the septic permit is issued for the septic system containing the Units; provided, however, that if a septic permit is not required by applicable law, the warranty period will begin upon the date that installation of the septic system commences. To exercise its warranty rights, Holder must notify Infiltrator in writing at its Corporate Headquarters in Old Saybrook, Connecticut within fifteen (15) days of the alleged defect. Infiltrator will supply replacement Units for Units determined by Infiltrator to be covered by this Limited Warranty. Infiltrator's liability specifically excludes the cost of removal and/or installation of the Units.

(b) THE LIMITED WARRANTY AND REMEDIES IN SUBPARAGRAPH (a) ARE EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE UNITS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE

(c) This Limited Warranty shall be void if any part of the chamber system is manufactured by anyone other than Infiltrator. The Limited Warranty does not extend to incidental, consequential, special or indirect damages. Infiltrator shall not be liable for penalties or liquidated damages, including loss of production and profits, labor and materials, overhead costs, or other losses or expenses incurred by the Holder or any third party. Specifically excluded from Limited Warranty coverage are damage to the Units due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Units; the Units being subjected to vehicle traffic or other conditions which are not permitted by the installation instructions; failure to maintain the minimum ground covers set forth in the installation instructions; the placement of improper materials into the system containing the Units; failure of the Units or the septic system due to improper siting or improper sizing, excessive water usage, improper grease disposal, or improper operation; or any other event not caused by Infiltrator. This Limited Warranty shall be void if the Holder fails to comply with all of the terms set forth in this Limited Warranty. Further, in no event shall Infiltrator be responsible for any loss or damage to the Holder, the Units, or any third party resulting from installation or shipment, or from any product liability claims of Holder or any third party. For this Limited Warranty to apply, the Units must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Infiltrator's installation instructions.

(d) No representative of Infiltrator has the authority to change or extend this Limited Warranty. No warranty applies to any party other than the original Holder.

The above represents the Standard Limited Warranty offered by Infiltrator. A limited number of states and counties have different warranty requirements. Any purchaser of Units should contact Infiltrator's Corporate Headquarters in Old Saybrook, Connecticut, prior to such purchase, to obtain a copy of the applicable warranty, and should carefully read that warranty prior to the purchase of Units.

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Appendix H

Cost Estimation Tables
Wastewater Treatment & Disposal

Table H-1. Preliminary Construction Cost Estimate
Alternative 3 - Primary Treatment w/PD Leachfield System - Dickson Ridge
Treatment and Disposal

Parcels: 100	**Design Flow: 13,500 gpd**			
Treatment - N/A, Prmary Treatment				
Treatment Subtotal				$ -
Land and Site Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 100,000	$ 100,000
Clearing - Preparation	AC	3	$ 25,000	$ 75,000
Fencing	LF	3,000	$ 25	$ 75,000
Land and Site Improvements Subtotal				**$ 250,000**
PD Chamber Leachfield System				
Duplex Dosing Siphon, 2,500 gal tank	LS	2	$ 50,000	$ 100,000
PD Chamber Leachfield	LF	3,400	$ 125	$ 425,000
Distribution Piping, Valves & Appurtenances	LF	5,000	$ 50	$ 250,000
Monitoring Wells	EA	6	$ 2,500	$ 15,000
Disposal Subtotal				**$ 790,000**
Treatment and Disposal Subtotal				$ 1,040,000
Miscellaneous & Contingencies @ 20%				$ 208,000
Engineering & Permitting @ 20%				$ 208,000
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST				**$ 1,456,000**
ESTIMATED COST PER PARCEL				**$ 9,707**

TOTAL ESTIMATED COLLECTION COST	**$ 4,559,500**
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 1,456,000**
TOTAL ESTIMATED PROJECT COST	**$ 6,015,500**
ESTIMATED COST PER PARCEL	**$ 60,155**

Table H-2. Preliminary Construction Cost Estimate
Alternative 3 - Primary Treatment w/PD Leachfield System - Dickson Ridge
Treatment and Disposal

Parcels: 150 **Design Flow: 20,250 gpd**

Treatment - N/A, Prmary Treatment				
Treatment Subtotal				$ -
Land and Site Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 100,000	$ 100,000
Clearing - Preparation	AC	3	$ 25,000	$ 75,000
Fencing	LF	3,000	$ 25	$ 75,000
Land and Site Improvements Subtotal				**$ 250,000**
PD Chamber Leachfield System				
Duplex Dosing Siphon, 2,500 gal tank	LS	2	$ 50,000	$ 100,000
PD Chamber Leachfield	LF	5,100	$ 125	$ 637,500
Distribution Piping, Valves & Appurtenances	LF	6,000	$ 50	$ 300,000
Monitoring Wells	EA	6	$ 2,500	$ 15,000
Disposal Subtotal				**$ 1,052,500**
Treatment and Disposal Subtotal				$ 1,302,500
Miscellaneous & Contingencies @ 20%				$ 260,500
Engineering & Permitting @ 20%				$ 260,500
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST				**$ 1,823,500**
ESTIMATED COST PER PARCEL				**$ 12,157**

TOTAL ESTIMATED COLLECTION COST	**$ 5,802,200**
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 1,823,500**
TOTAL ESTIMATED PROJECT COST	**$ 7,625,700**
ESTIMATED COST PER PARCEL	**$ 50,838**

Table H-3. Preliminary Construction Cost Estimate

Secondary Treatment w/PD Leachfield System - Dickson Ridge

Treatment and Disposal

Parcels: 150 **Design Flow: 20,250 gpd**

TREATMENT						
Treatment Site & Improvements						
Land Acqusition (Lease Agreement)	LS	1	$	50,000	$	50,000
Clearing - Preparation	AC	1	$	50,000	$	50,000
Fencing	LF	600	$	50	$	30,000
Entrance Road & Gate	LS	1	$	100,000	$	100,000
Land & Site Improvements Subtotal					**$**	**230,000**
Secondary Treatment System						
EQ Dosing Tank & Pumps	LS	2	$	75,000	$	150,000
Effluent Discharge Tank & Pumps	LS	1	$	75,000	$	75,000
Treatment Units Advantex	EA	3	$	200,000	$	600,000
Disinfection (Optional)	LS	1			$	-
Building and Landscaping	LS	1	$	75,000	$	75,000
Standby Generator	LS	1	$	100,000	$	100,000
Electrical, PG&E	LS	1	$	150,000	$	150,000
Treatment Subtotal					**$**	**1,150,000**
LEACHFIELD						
Leachfield Lease & Improvements						
Land Acqusition (Lease Agreement)	LS	1	$	100,000	$	100,000
Clearing - Preparation	AC	3	$	25,000	$	75,000
Fencing	LF	3,200	$	25	$	80,000
Land and Site Improvements Subtotal					**$**	**255,000**
PD Chamber Leachfield System						
Duplex Dosing Siphon, 2,500 gal tank	LS	2	$	50,000	$	100,000
PD Chamber Leachfield	LF	2,500	$	125	$	312,500
Distribution Piping, Valves & Appurtenances	LF	4,000	$	50	$	200,000
Monitoring Wells	EA	6	$	2,500	$	15,000
Disposal Subtotal					**$**	**627,500**
Treatment and Disposal Subtotal					$	2,262,500
Miscellaneous & Contingencies @ 20%					$	452,500
Engineering & Permitting @ 20%					$	452,500
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST					**$**	**3,167,500**
ESTIMATED COST PER PARCEL					**$**	**15,838**

TOTAL ESTIMATED COLLECTION COST	**$**	**5,802,200**
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$**	**3,167,500**
TOTAL ESTIMATED PROJECT COST	**$**	**8,969,700**
ESTIMATED COST PER PARCEL	**$**	**59,798**

Table H-4. Preliminary Construction Cost Estimate
Secondary Treatment w/PD Leachfield System - Dickson Ridge
Treatment and Disposal

Parcels: 200 **Design Flow: 27,000 gpd**

TREATMENT				
Treatment Site & Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 50,000	$ 50,000
Clearing - Preparation	AC	1	$ 50,000	$ 50,000
Fencing	LF	600	$ 50	$ 30,000
Entrance Road & Gate	LS	1	$ 100,000	$ 100,000
Land & Site Improvements Subtotal				**$ 230,000**
Secondary Treatment System				
EQ Dosing Tank & Pumps	LS	3	$ 75,000	$ 225,000
Effluent Discharge Tank & Pumps	LS	1	$ 75,000	$ 75,000
Treatment Units Advantex	EA	4	$ 200,000	$ 800,000
Disinfection (Optional)	LS	1		$ -
Building and Landscaping	LS	1	$ 100,000	$ 100,000
Standby Generator	LS	1	$ 100,000	$ 100,000
Electrical, PG&E	LS	1	$ 150,000	$ 150,000
Treatment Subtotal				**$ 1,450,000**
LEACHFIELD				
Leachfield Lease & Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 100,000	$ 100,000
Clearing - Preparation	AC	3	$ 25,000	$ 75,000
Fencing	LF	3,000	$ 25	$ 75,000
Land and Site Improvements Subtotal				**$ 250,000**
PD Chamber Leachfield System				
Duplex Dosing Siphon, 2,500 gal tank	LS	2	$ 50,000	$ 100,000
PD Chamber Leachfield	LF	3,400	$ 125	$ 425,000
Distribution Piping, Valves & Appurtenanc	LF	5,000	$ 50	$ 250,000
Monitoring Wells	EA	6	$ 2,500	$ 15,000
Disposal Subtotal				**$ 790,000**
			Treatment and Disposal Subtotal	$ 2,720,000
			Miscellaneous & Contingencies @ 20%	$ 544,000
			Engineering & Permitting @ 20%	$ 544,000
			TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 3,808,000**
			ESTIMATED COST PER PARCEL	**$ 19,040**

TOTAL ESTIMATED COLLECTION COST	**$ 7,726,700**
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 3,808,000**
TOTAL ESTIMATED PROJECT COST	**$ 11,534,700**
ESTIMATED COST PER PARCEL	**$ 57,674**

Table H-5. Preliminary Construction Cost Estimate
Secondary Treatment w/PD Leachfield System - Dickson Ridge
Treatment and Disposal

Parcels: 250 **Design Flow: 33,750 gpd**

TREATMENT				
Treatment Site & Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 50,000	$ 50,000
Clearing - Preparation	AC	1	$ 50,000	$ 50,000
Fencing	LF	800	$ 50	$ 40,000
Entrance Road & Gate	LS	1	$ 100,000	$ 100,000
Land & Site Improvements Subtotal				**$ 240,000**
Secondary Treatment System				
EQ Dosing Tank & Pumps	LS	3	$ 75,000	$ 225,000
Effluent Discharge Tank & Pumps	LS	1	$ 75,000	$ 75,000
Treatment Units Advantex	EA	5	$ 200,000	$ 1,000,000
Disinfection (Optional)	LS			$ -
Building and Landscaping	LS	1	$ 100,000	$ 100,000
Standby Generator	LS	1	$ 100,000	$ 100,000
Electrical, PG&E	LS	1	$ 150,000	$ 150,000
Treatment Subtotal				**$ 1,650,000**
LEACHFIELD				
Leachfield Lease & Improvements				
Land Acqusition (Lease Agreement)	LS	1	$ 100,000	$ 100,000
Clearing - Preparation	AC	3	$ 25,000	$ 75,000
Fencing	LF	3,000	$ 25	$ 75,000
Land and Site Improvements Subtotal				**$ 250,000**
PD Chamber Leachfield System				
Duplex Dosing Siphon, 2,500 gal tank	LS	2	$ 50,000	$ 100,000
PD Chamber Leachfield	LF	4,200	$ 125	$ 525,000
Distribution Piping, Valves & Appurtenances	LF	6,000	$ 50	$ 300,000
Monitoring Wells	EA	6	$ 2,500	$ 15,000
Disposal Subtotal				**$ 940,000**
			Treatment and Disposal Subtotal	$ 3,080,000
			Miscellaneous & Contingencies @ 20%	$ 616,000
			Engineering & Permitting @ 20%	$ 616,000
			TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 4,312,000**
			ESTIMATED COST PER PARCEL	**$ 17,248**

TOTAL ESTIMATED COLLECTION COST	**$ 9,031,700**
TOTAL ESTIMATED TREATMENT AND DISPOSAL COST	**$ 4,312,000**
TOTAL ESTIMATED PROJECT COST	**$ 13,343,700**
ESTIMATED COST PER PARCEL	**$ 53,375**

Appendix I

Institutional & Management Information

APPENDIX I
INSTITUTIONAL AND MANAGEMENT INFORMATION

This section addresses management issues. Specifically, it provides background information regarding management requirements and alternatives for a community wastewater system as well as for an onsite wastewater management approach for the Woodacre study area.

COMMUNITY WASTEWATER FACILITIES MANAGEMENT REQUIREMENTS

A community wastewater project in Woodacre would involve construction of physical wastewater facility improvements for up to potentially 250 existing homes and businesses located in the study area. Different wastewater improvement alternatives have been identified, evaluated and compared. If the community decides to move forward, project selection would be made upon completion of an environmental impact report and in connection with securing necessary governmental and local sources of funding to finance the project.

Management requirements for implementation and ongoing operation of a community wastewater project include the following:

- **Public Entity for Facility Ownership and Operation**. A public entity will be required to assume responsibility for ownership and ongoing operation of any community facilities that are constructed. A public entity is also required to oversee the construction of the wastewater facility improvements, including the acquisition and management of funding for construction as well as for ongoing operation and maintenance. The public entity formed for ongoing operation and maintenance must be in place prior to initiation of project construction.

- **Assessment District for Construction Financing.** Grant funding from State, Federal or other sources may available for the implementation of a community wastewater project for Woodacre. Such funds could be used to pay for administration, planning and design-related services, and construction costs; however, it is likely that any grant funds would only be able to cover a portion of the total costs. For example, in the Marshall Phase 1 Community Wastewater Project, grant funds covered roughly half of the overall project costs; the remaining costs ("local share") were financed through the formation of a local assessment district. This is one of the most common methods used to finance sewer systems and other public works projects. The assessments, secured against the properties in the project service area, are used to support low-interest loans and/or the sale of bonds to pay for the balance of the construction costs not covered by grants.

- **Ongoing Operation and Maintenance/Management Fees.** Once constructed, the project facilities will require ongoing operation and maintenance, the costs for which will be paid through the collection of fees or user charges from all properties served by the project. These fees are normally collected as part of the annual tax bill; however, they may be collected through direct billing, which is more cumbersome and not as common. The annual operation and maintenance costs will vary depending upon the specific facilities included in the selected project as well as the number of service connections. A review of anticipated operation and maintenance requirements and costs for the various project alternatives is covered in **Section 6**.

WOODACRE ONSITE WASTEWATER MANAGEMENT PROGRAM

Although not identified as the preferred project, Alternative #2 presents the option of upgrading individual onsite septic systems along with ongoing management and oversight. Implementation of this alternative would require the establishment of an onsite wastewater management program (also “management district” or “management zone”) that covers all developed properties within the defined service area. The aim would be to develop and implement a local program to help finance and oversee the implementation of onsite wastewater system improvements, and for ongoing oversight of all systems in the service area.

The functions of an onsite wastewater management district can range widely, depending on the goals, the facilities to be maintained, local resources and capacity to undertake management and maintenance responsibilities. Some of the key functions of a management program for the Woodacre would likely include:

- Inspect and monitor individual onsite system upgrades;
- Conduct ongoing water quality monitoring of groundwater and/or surface waters in selected areas;
- Plan and develop additional wastewater improvement project phases;
- Seek grant funds or other financing for other phases of improvements, and for direct assistance to homeowners;
- Provide reports to the County, Regional Water Board and others on the status of wastewater-water quality conditions in the Woodacre area; and
- Represent the Woodacre property owners in regulatory matters concerning wastewater system requirements for the area.

The institutional and financial requirements for implementing an onsite wastewater management program would include the same basic items previously described for a community wastewater facility, with some variation as described below.

- **Public Entity.** Formation of a public entity (i.e., management district) would be required to obtain and utilize public grants or loan assistance for implementing onsite wastewater improvements and to carry out the ongoing septic system oversight and management functions. In the future, a public entity could also potentially implement other wastewater improvement projects in the Woodacre area.

- **Assessment District and Loans.** An assessment district could potentially be formed to help finance onsite wastewater improvements. However, since assessment districts are normally used for financing facilities that serve the common good, rather than individual property improvements, there is little experience in this area and finding suitable lending sources may be difficult. Alternatively, a loan program could potentially be set up by the public management district to make low-interest State funds available to private property owners to help finance individual onsite improvements.

- **Ongoing Operation and Maintenance/Management Fees.** Costs to maintain and oversee the onsite wastewater improvements would be paid for by user fees from the homeowners in the Woodacre service area. Similar to the requirements for a community wastewater facilities project, such fees would go toward the payment of district administration and overhead costs, technical services/equipment for inspections, monitoring of individual systems, water quality sampling costs, and reporting. The fees could be included on the tax bill or collected through direct billings. The fee structure could be customized to reflect different levels of management oversight. For example, a fee structure could be established to charge a uniform base rate to all properties, with additional fees assigned according to the type of technology (standard or advanced system), monitoring frequency, etc.

INSTITUTIONAL ALTERNATIVES

Introduction

The implementation of a community wastewater project in Woodacre will require the formation of or annexation to a public district that has suitable powers and authority for operation and management of public sewers. This is required as a matter of public policy and also to enable the community to obtain and utilize various forms of public financial assistance available from the State and Federal government.

Provided here is a brief overview of the potential options available along with some of the key considerations that may influence the local decision on an appropriate institutional arrangement for the community. In general, all options presented here are technically viable; the ultimate decision by the community will likely focus on issues of local autonomy, economics and possibly political or personal preferences.

Existing Institutions

The present wastewater feasibility study is being conducted by the County of Marin, which has general authority for wastewater management throughout the unincorporated area of the County. Acting in this general capacity, the County has the authority to continue through the design and construction phase of the project, if this is desired. This is the approach that was followed for the Marshall Phase Community Wastewater System (Phases 1 and 2). However, ultimately a district will be needed for the operation and maintenance of the facilities that are constructed or for the governance of an onsite wastewater management program, if that option is selected.

Presently, there are two local districts with sewerage powers that encompass or are in reasonable proximity to Woodacre: (1) Marin Municipal Water District (Marin Water); and (2) Ross Valley Sanitary District (RVSD). Marin Water provides water service to the area and has the authority to expand its scope of activities to include wastewater services. However, this would be a significant departure from existing operations and to date Marin Water has not indicated any interest in taking on sewer service responsibilities. RVSD operates an extensive sewer collection system with sewer service boundaries that extend to Fairfax. RVSD indicated ability and interest in providing sewer service to the broader San Geronimo Valley; but there has no discussion of sewers only service the Woodacre area.

Independent Local Districts

Independent local districts are those formed to carry out a specific local public function, where the administration and decision-making is entrusted to a locally elected Board of Directors. This board assumes the responsibility for all policy, staffing and fiscal matters for the properties within the district. The boundaries of the district are established to encompass the areas benefiting from the district facilities or activities. Common types of independent local districts pertinent to the provision of sewerage services include:

- **Community Services District (CSD)**. These districts have the authority to provide a broad range of public services, including police and fire protection, recreation, and lighting, as well as water and sewer service. The formation of a CSD is initiated by local initiative; i.e., petition to the Board of Supervisors. An election is required for district formation and for election of the Board of Directors. The election can be waived if the petition includes at least 80 percent of the registered voters in the proposed district. There are no existing CSDs in the San Geronimo Valley. However, there are other CSDs in West Marin, e.g., Tomales Village CSD, which operates the community's wastewater collection, treatment, and disposal facilities.

- **County Water Districts**. These local districts, authorized under the California Water Code, are formed in a similar manner to CSDs. But their powers are limited to provision of water and sewer service within their boundaries. Stinson Beach County Water District (SBCWD) is an example of this type of district. The SBCWD, with a locally elected board of directors, provides water service and also manages the onsite wastewater management program for the entire Stinson Beach community. Marin Water is a municipal water district with similar structure and powers as a county water districts, and supplies water to large portions of the population in Marin County, including incorporated and unincorporated areas.

- **Sanitary Districts**. These districts are authorized under the Health and Safety Code specifically for the provision of sewage collection, treatment and disposal services. They can also provide water service. They are formed in a manner similar to CSDs and County Water Districts. The governing board of a Sanitary District is locally elected. Presently, there are no Sanitary Districts or County Sanitation Districts in West Marin. However, there are several sanitary districts throughout other parts of the County, such as the Ross Valley Sanitary District, Novato Sanitary District, and Las Gallinas Sanitary District.
- **Public Utility Districts.** These districts are authorized under the State Public Utilities Code and can provide a wide range of utility services, including sewer and water service.

Public Utility Districts (PUD) can only be formed in unincorporated areas. They are governed by a locally elected board consisting of either three or five members. Inverness PUD and Bolinas Community PUD are local examples of PUDs in Marin County. Both of these districts provide water service within their districts; Bolinas Community PUD also owns and operates community sewerage facilities serving the downtown area of Bolinas.

Some of the common advantages of independent local districts include: (1) local autonomy in the decision-making process; and (2) local accountability and control over costs. The disadvantages of independent local districts may include: (1) limited financial resources and leverage; (2) limited economies of scale; and (3) limited resources and ability to meet public service demands. However, as in the case of Marin Water and RVSD, independent water and wastewater districts can be large enough to encompass multiple jurisdictions and overcome economy of scale limitations.

County-Dependent Districts

This category encompasses those districts formed and administered as sub-sets of County government. The County Board of Supervisors serves as the governing body or decision-maker for these districts. The Board of Supervisors acts as the Board of Directors for various dependent districts. As such, they assume responsibility for all policy, staffing, debt and rate structures within the boundaries of the district.

Marin County utilizes dependent districts to provide such things as sewer maintenance, landscape maintenance, lighting, recreation, fire protection, drainage and paramedic services. Marin County Counsel provides legal service. The Board of Supervisors typically works with a Citizen's Advisory Committee within each of the dependent districts to provide an opportunity for local input to the decision-making process.

Examples of County-dependent districts in Marin County include the following:

- **County Service Areas (CSA)**. County service areas are much the same as CSDs in their range of authority. The key distinction is the governing body, which is the Board of Supervisors for all CSAs. They can be formed by either local petition or by a resolution of the Board of Supervisors. Presently, there are 16 CSAs in Marin County providing a variety of public services, ranging from park and open space management to drainage maintenance. There are currently no existing CSAs in Marin County that provide sewer services. However, in neighboring Sonoma County, a county-wide CSA, with multiple zones of benefit, is used to provide wastewater treatment and disposal services for several unincorporated communities.

- **Sanitation Districts**. These districts are authorized under the Health and Safety Code specifically for the provision of sewage collection, treatment and disposal services. They can also provide water service. It can include unincorporated and incorporated areas; its governing board is made up of County Supervisors and/or City Council members, depending upon the makeup of the district. A sanitation district may be formed upon local petition and Board approval. San Rafael Sanitation District is currently the only County

Sanitation District in Marin County. It was formed to manage the sewer collection system for the San Quentin area; collected sewage is treated at the Central Marin Sanitation Agency Wastewater Treatment Plant.

- **Onsite Wastewater Management Districts.** The concept of public management of onsite wastewater disposal was developed in California in the mid-1970s to expand wastewater options in rural and suburban communities, specifically by providing a means for more effective planning, operation, and maintenance of onsite systems. The enabling legislation, Senate Bill 430, became law in January 1978 and was added to the California Health and Safety Code, commencing with Section 6950. This legislation enables public agencies that have powers to manage sewerage systems to form, under certain specified conditions, Onsite Wastewater Disposal Zones (Zones) in order to provide for the collection, treatment, reclamation or disposal of wastewater without the use of community-wide sanitary sewers or sewage systems. Such Zones may also manage community leachfield systems. Public agencies empowered to form such Zones include qualified special districts such as county service areas, community services districts, utility districts, sanitation districts, water districts, etc., as well as cities. The Zone formed under the Health and Safety Code is the area defined for operation and maintenance of onsite wastewater systems by the public agency. In 2007 the County of Marin formed the Marshall Onsite Wastewater Disposal Zone to serve as the governing entity for the Marshall Phase 1 Community Wastewater System, and expanded the Zone in 2014 to include additional properties (Marshall Phase 2 area).

The main advantages of County-dependent districts include: (1) availability of county resources and associated economies of scale; (2) financial strength and leverage for bonding and contracting. The key disadvantages of County-administered districts include: (1) reduced local control of the decision-making process; and (2) reduced ability to influence fiscal matters, e.g., through voluntary/community service or other cost reduction measures (e.g., County overhead, travel time and costs).

LAFCO

The Local Agency Formation Commission (LAFCO) was created by the Legislature in 1963 to discourage urban sprawl and encourage the orderly formation and development of local government agencies. There is a LAFCO in each county in California except the City and County of San Francisco. LAFCO is a seven-member Commission comprised of two city council members (chosen by the Council of Mayors), two county supervisor members (chosen by the Board of Supervisors), two special district members (chosen by Independent Special District election), and one public member (chosen by the members of the Commission).

LAFCO has four major functions under State law:

1) To review and approve or disapprove proposals for changes in the boundaries or organization of cities and special districts in the county (including annexations to or detachments from cities and districts, incorporations of cities, formations of districts, and the dissolution, consolidation or merger of special districts), applications for activation of

special district latent powers, and applications to provide service outside of a city or district boundary;

2) To establish and periodically update the sphere of influence or planned service area boundary for each city and special district;
3) To initiate and assist in studies of existing local government agencies with the goal of improving the efficiency and reducing the costs of providing urban services; and
4) To provide assistance to other governmental agencies and the public concerning changes in local government organization and boundaries.

With regard to the formation of County Service Areas, the Marin LAFCO implements the following policy:

> *"County Service Area (CSA) Policy*
>
> *A County Service Area may be formed when unincorporated areas that are located outside municipal sphere-of-influence boundaries desire extended urban-type services including police and fire protection from the County of Marin.*
>
> *Unincorporated lands located within a municipal sphere-of-influence boundary should not be eligible to receive extended urban-type services from the county in the form of a County Service Area except when (a) evaluation on a case-by-case basis justifies creation and (b) the affected city, by letter, expresses approval of such action. (Originally Adopted: July 13, 1977; Revised: January 13, 1983)"*

Woodacre does not fall within the sphere-of-influence boundary of any municipality. LAFCO policy concerning the formation of County Service Areas would appear to permit the establishment of a CSA for the provision of wastewater collection and treatment services for the Woodacre area.