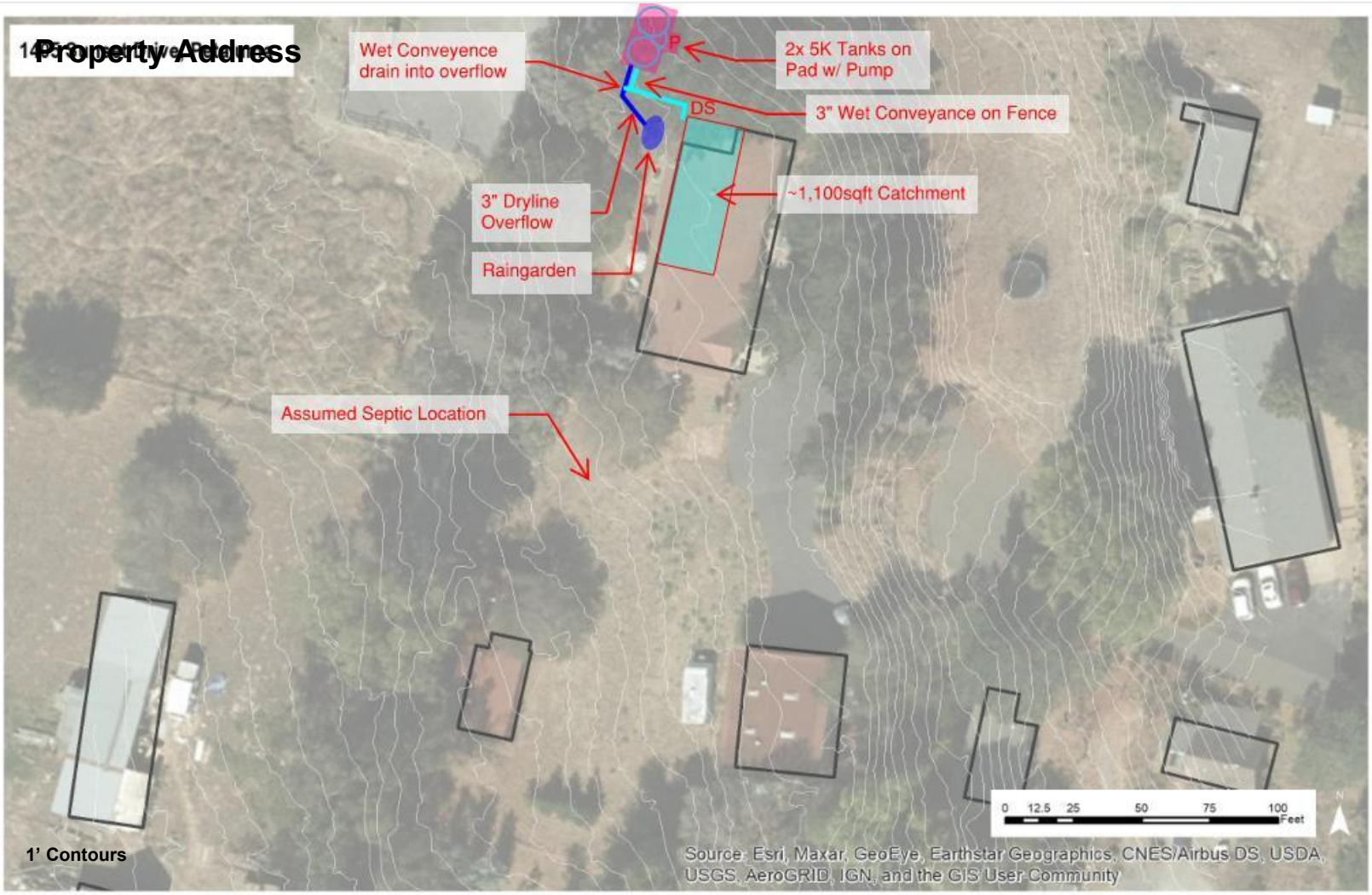
July 12, 2022
Board Meeting
ASR "C"
Provided at meeting

Rural Rainwater Harvesting for Irrigation Feasibility Report

SHERWOOD
DESIGN ENGINEERS

Feasibility Report for:



NARRATIVE AND CALCULATIONS

PROJECT INFORMATION:

System Function

The proposed system is intended to harvest, prefilter, store and reuse rainwater for landscape drip irrigation. The intended use of the rainwater is for a proposed fruit tree orchard in the open field northeast of the proposed tank. The total water demand is unknown. Rainwater will be collected from roof at one downspout, indicated with a "DS". This collects roughly 1,100 square feet of roof, sufficient to fill the proposed tanks. To increase the collection, the middle downspout on this section of roof has a riser pipe installed to divert more catchment to the tanks during small rainfall events but allows normal gutter function during large events. A leaf deflector will be installed underneath the downspout and connected into sealed 3" pipe. No First Flush system is planned as the owner intends to operate the wet line conveyance as a first flush during the first storm of the year. The wet-line conveyance will run either underground or along the fence to the tank pad, where it will rise and enter the factory provided inlet fitting to the tank. The top of the wet line pipe entering the tank must be at a minimum 6" below the bottom of the leaf screen pipe. At the lowest point of the pipe, it will be equipped with a "T" fitting which leads to a 2" ball valve. This drains either to a raingarden or infiltration pit or connects to the overflow pipe. The proposed system includes two 4,995-gallon plastic water tanks, with a width of 12 feet. The tanks will be located on 6" of compacted 3/4" angular gravel or 3/4" Class 2 Aggregate Base "Road Base". The pad will be built atop a level subgrade of compacted native soil, with no fill over 1'. Where the gravel pad is higher than the surrounding soil, it will be retained by 2x6" pressure treated or other ground contact approved material, or the flat pad extended to 3' beyond the tanks to allow the gravel to slope to grade. The tanks are plumbed together using the factory provided bottom fittings with a flexible coupling and shut-off valves. The tank which receives the water from the roof has a 3" pipe installed 2" lower than the inlet, which acts as a 3" dryline conveyance to an overflow raingarden. Stored water will be pressurized with an irrigation pump located beside the tanks. No connection to any other water system is planned.

Permits

The proposed system is subject to a building permit due to the proposed irrigation pump. The remaining systems of collection, conveyance, storage and overflow of rainwater are not subject to a building code per California Plumbing Code Chapter 16.

CALCULATIONS:

COLLECTION VIABILITY: ROOF AREA*LOCAL DROUGHT RAINFALL*0.623 * Catchment Eff= GALLONS AVAILABLE

COLLECTION VIABILITY: 1,100 SQFT * 19 INCHES * 0.623 * 0.86= 11,065 GALLONS

VOLUME OF OVERFLOW IN 0.5" RAINFALL IN GALLONS: 0.5" * ROOF AREA * 0.623 = GALLONS OF OVERFLOW

VOLUME OF OVERFLOW IN 0.5" RAINFALL IN GALLONS: 0.5" * 1100 SQFT* 0.623 = 342 GALLONS

SIZE OF SWALE TO HOLD THE OVERFLOW VOLUME : GALLONS OF OVERFLOW / 3.7-GAL PER LINEAR FT OF SWALE

SIZE OF SWALE NEEDED TO HOLD THE OVERFLOW VOLUME: 92 FT.

SIZE OF RAINGARDEN TO HOLD THE OVERFLOW VOLUME: GALLONS OF OVERFLOW / 3-GAL PER SQUARE FOOT OF RAIN GARDEN

SIZE OF RAINGARDEN NEEDED TO HOLD THE OVERFLOW VOLUME: 114 SQFT.

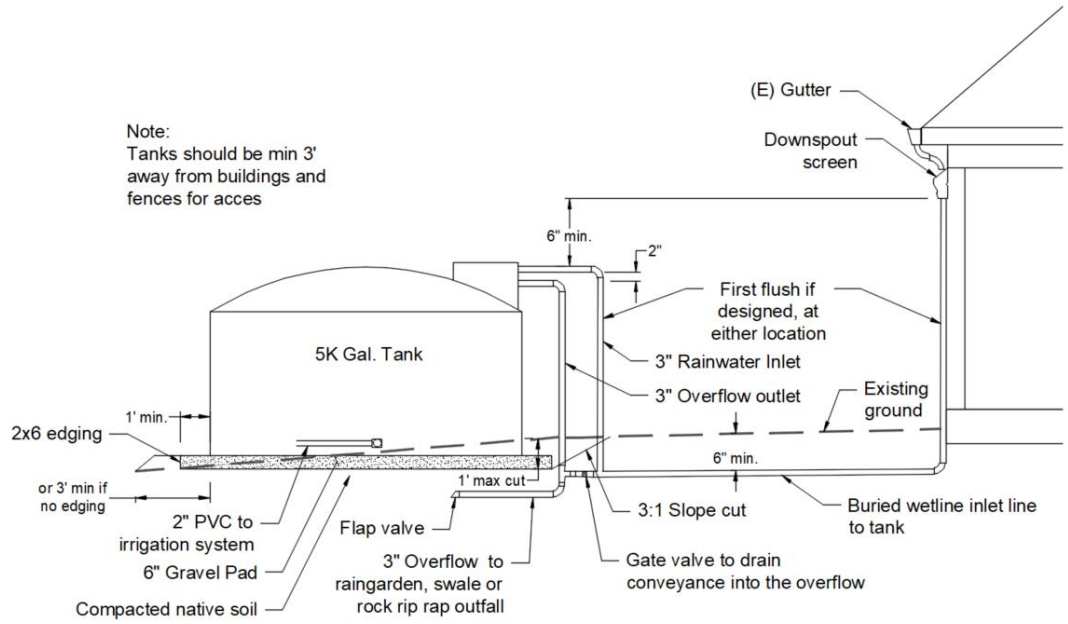
*ASSUMES FIRST 24 HRS OF INFILTRATION IS FROM SELF CATCHMENT, ALL COLLECTION INFILTRATED BEFORE 72 HRS

POTENTIAL FOR RAINWATER USE: 10,000 GALLONS OF STORAGE CAN IRRIGATE ONE OF THE FOLLOWING.

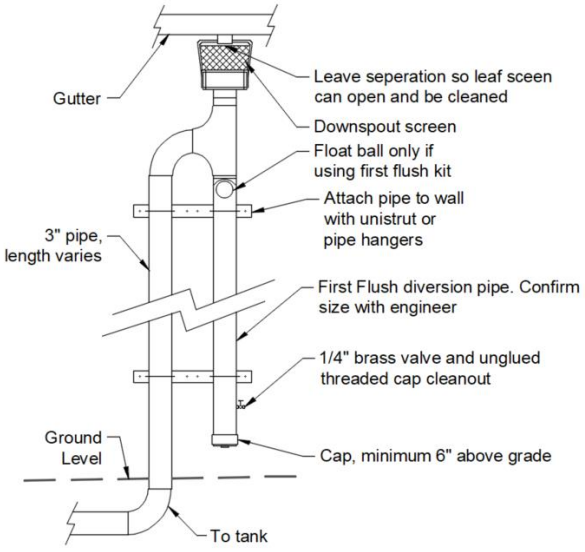
☐ 20 FRUIT TREES OR ☐ 415 SQFT. OF VEGETABLE GARDEN OR ☐ 1,200 SQFT. OF LOW WATER LANDSCAPE

NOTES: ESTIMATED USING DRIP IRRIGATION FOR WATER DEMAND IN SANTA ROSA, CALIFORNIA.

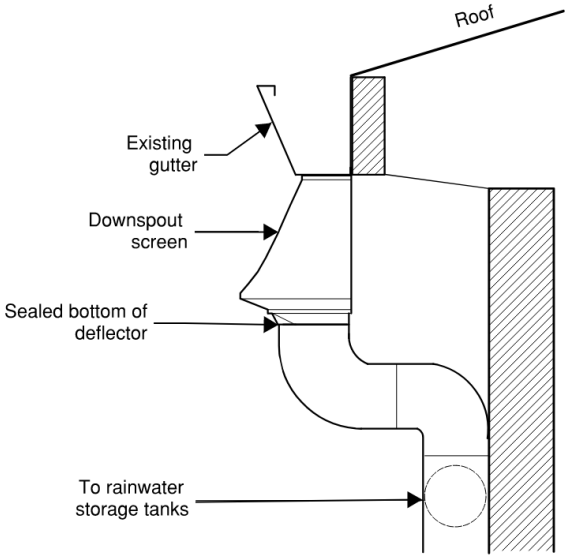
PROPOSED DETAILS



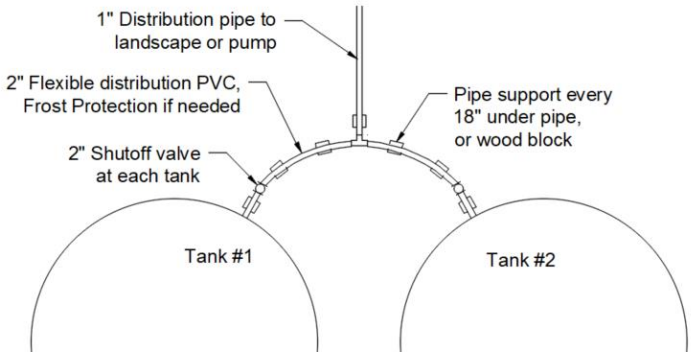
A WETLINE CONVEYANCE



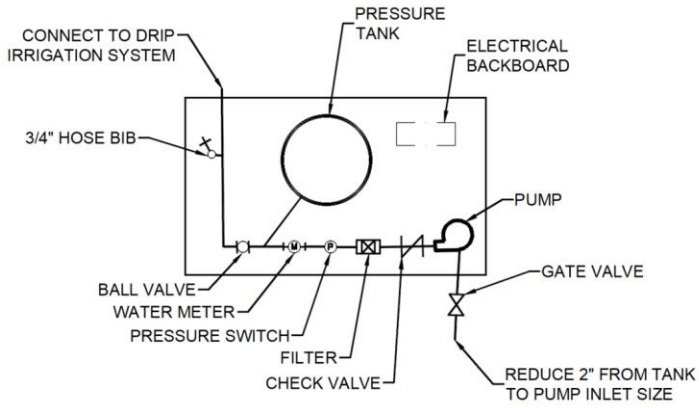
B WETLINE CONVEYANCE PRETREATMENT



C LEAF DEFLECTOR SCREEN UNDER GUTTER OR WALL



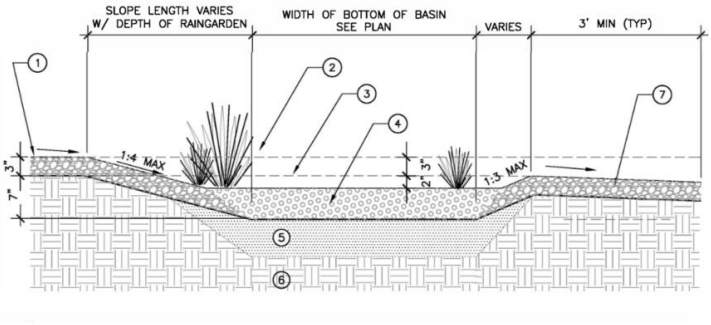
D MULTIPLE TANK CONNECTION



E PUMP SYSTEM

SHERWOOD DESIGN ENGINEERS

PROPOSED DETAILS



1. SWALE OR SHEET FLOW INTO RAIN GARDEN FROM DS OR PAVING AREA. COVER SOIL W/ 3" OF RIVER COBBLE 1.5"–6" IN SIZE.
2. TOP ELEVATION OF THE BERM AROUND RAIN GARDEN. 3" ABOVE MAX PONDING LEVEL.
3. ELEVATION OF MAX PONDING DURING STORM EVENT. PONDING OF 2" OF RAINWATER ABOVE PEA GRAVEL.
4. 5" PEA GRAVEL MULCH INSURES NO PONDING WITHIN 72 HRS FOR MOSQUITO CONTROL. TOTAL DEPTH INCLUDING PONDING IS 7".
5. SCARIFY & AMEND NATIVE SOIL AT BOTTOM OF RAIN GARDEN.
6. UNDISTURBED SUBGRADE.
7. 3" THICK OF 1.5–6" RIVER COBBLE. EXTEND 3' DOWNSLOPE FROM RAINGARDEN. INSTALL LEVEL SPREADER TO RETURN TO SHEET FLOW AS NEEDED BY DESIGN.

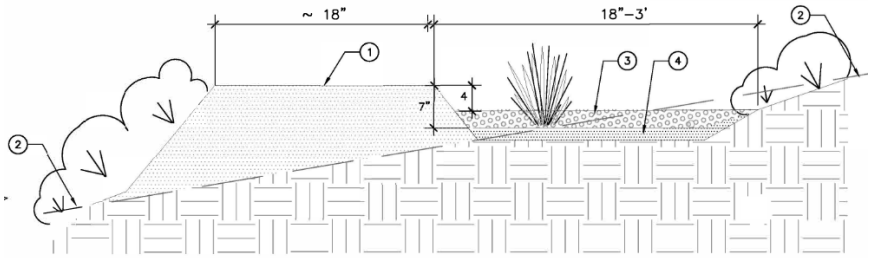
NOTES:
1. RAINWATER GARDEN DESIGNED FOR CLAY SOILS. MAX DEPTH 7" OF WHICH 5" HAS A PEA GRAVEL MULCH.
2. NO WOOD CHIP OR BARK MULCH IN RAINWATER SYSTEMS TO AVOID CLOGGING STORM DRAINS DOWNSTREAM.

A VEGETATED RAINGARDEN SECTION

1. BERM; CONSTRUCT WHILE DIGGING BASIN. CAN BE MADE WIDER TO BE A WALKING PATH
2. EXISTING SLOPE 8% OR LESS
3. 3" PEA GRAVEL MULCH INSURES NO PONDING WITHIN 72 HRS FOR MOSQUITO CONTROL. TOTAL DEPTH INCLUDING PONDING IS 7". WOODCHIP MULCH OR NATURAL VEGETATION OK WHEN NOT CONNECTED TO STORM DRAINS

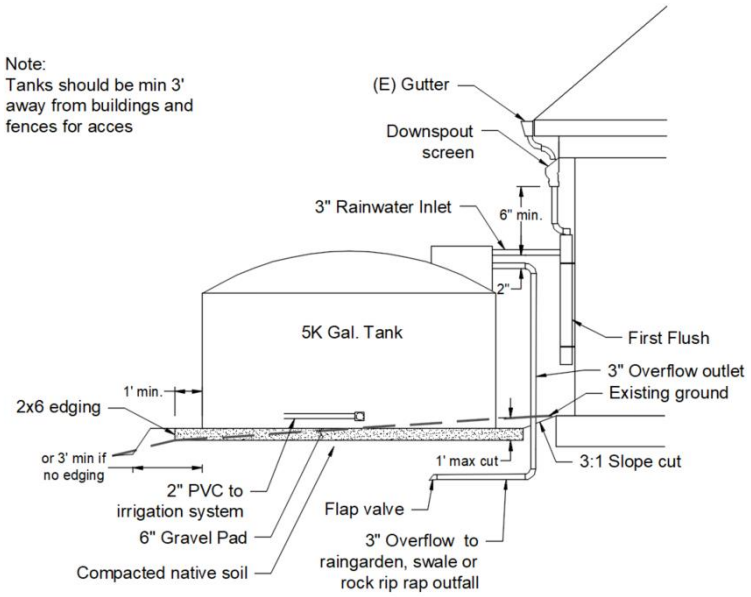
SCARIFY & AMEND NATIVE SOIL AT BOTTOM OF RAIN GARDEN

4. UNDISTURBED SUBGRADE

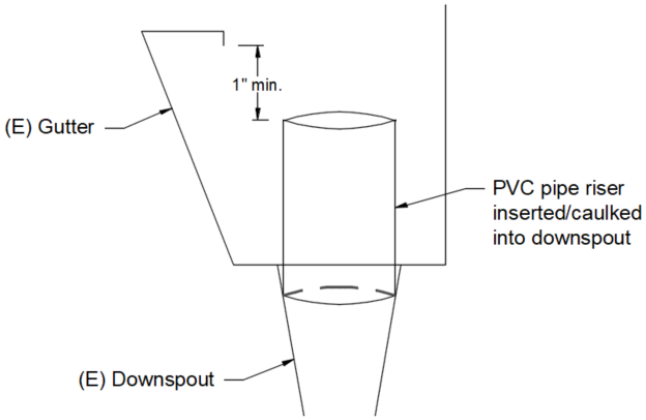


B SWALE/CASCADE ON SLOPE - SECTION

ALTERNATE/ADDITIONAL DETAILS



A DRYLINE CONVEYANCE



B PIPE RISER IN GUTTER

OTHER REFERENCES

How To Harvest Rainwater From Your Roof
https://www.youtube.com/watch?v=DhEaKdmHeCk

Webpage and PDF detailing conveyance and First Flush systems
https://oaec.org/publications/roof-water-harvesting-for-a-low-impact-water-supply/

Webpage and PDFs detailing infiltration swales and raingardens
https://oaec.org/publications/integrated-stormwater-retention-system/

Webpage and PDFs describing infiltration swales, raingardens and other water management systems
https://oaec.org/publications/slow-it-spread-it-sink-it/

Maintaining your Rainwater System
https://www.youtube.com/watch?v=boyUkU_TocU&t=10s

MATERIALS NOTES

Conveyance Pipes
-Unless otherwise noted, use 3" Sched 40 PVC for conveyance pipes from the roof to the tank. Pipes will last longer if painted. Schedule 80 has better longevity at a higher price. Thinner wall pipe can be used underground if 12" of soil cover and it can be sealed water tight.
-Most large tanks come with a 1.5" tank inlet fitting close to the access hatch. Reduce the 3" pipe to this fitting to avoid buying another 3" tank inlet fitting
-All pipes must be glued and sealed from bottom of leaf deflector to the tank inlet
-All wet lines must have a drain valve installed at their lowest point
-Wet line drains can convey to their own rain garden or swale, or be connected to the overflow pipe which has an overflow
-If your area experiences significant freezes, consider draining wet line before frosts

Debris Exclusion
-Leaf Deflectors must have mesh no larger than 1/16" (12 Mesh) to prevent mosquitos, example product "Rain Harvesting Pty Leaf Eater Advanced"
-Gutter screens can reduce debris, but make cleaning gutters more difficult
-First flush columns can be custom made or a kit and contain the designed volume of water. Different size pipes can be used to meet designed volume
-First flushes need a valve or threaded plug at bottom to clean out debris/sludge after the year's first and last rain
-Many first flush manual and automatic drains exist. Simple system is installing a ¼" brass ball valve ~6" from the bottom. Leave valve slightly open during rainy season with a slow drip so column drains after ~1-2 weeks, to dispose the first dirty rain after a dry spell
-Example First Flush kit: https://www.rainharvest.com/rain-harvesting-pty-first-flush-diverter-for-post-or-wall-mounting.asp

Tank Overflow
-For overflow, install new 3" fittings (either screw type bulkhead or "multi-tite" rubber gasket). To cut holes in tanks, use hole saw running in reverse.
-Overflow from tank must be managed to avoid increasing runoff to neighboring parcels, and should prevent soil erosion of flooding of buildings
-A common solution is to reintroduce the overflow back into the drain system which originally drained the roof
-Where possible and responsible, infiltrate tank overflow into simple earthworks like swales or rain gardens
-Tank overflow must prevent mosquitos or vermin entering tank, such as a flapper valve or screen

Tank Pad
-Pad must be ¾" angular gravel, or ¾" Class 2 Aggregate Base "Road Base" . Round decorative gravel can be placed on pad after tanks installed
-Retaining with 2x6" pressure treated wood or other durable material is needed when pad material is not confined by a cut soil slope
-Pad is level to 1' beyond tanks if retained by 2x6" pressure treat/redwood edging, or 3' beyond tanks if gravel allowed to ramp down to existing grade
-Excavate native soil to stable soil, graded flat and compacted when damp, removing topsoil, roots and organic matter
-Compact with vibratory plate or hand tamper, when damp
-Unless supervised by an engineer or landscape professional, pads should be on cut, not filled/built-up soil
-Unless supervised, cuts to be 1-foot maximum depth, with new slopes cut back to 3:1 (3' long for every 1' high) slope for stability, or otherwise retained

Tank Connections:
-If installing additional penetrations at bottom of tank, use bolted "banjo" type 2" bulkheads to prevent leaks.
-When connecting multiple tanks, use 2" flexible pvc "spa hose", glued into other pvc fittings, to prevent cracking when tanks shift, or flexible metal hose

Tank Level Indicator
-If water level indicator is used, must provide no entry of mosquitos, and no allow algae growth. For example, Liquidator 2

Pump Systems
-Pump on 3x4' concrete pad, protected from weather and freeze
-Intended use is residential landscape drip irrigation, assumed pumps are smaller than ¾ Horsepower. It is highly recommended that a contractor install all pump systems
-Pumps operating drip must provide minimum of 25 psi of pressure, higher if drip area is >100' away from pump or more than 5' upslope. Flow rate in Gallons per Minute (GPM) is dependent on size of drip irrigation field, typically 3-10 GPM
-Pressure tank should have a drawdown volume (this is different than its total volume, see manufacturers information) roughly equal to the flow rate of the pump
-Pump system must be equipped with a check valve, pressure switch, run-dry protection and 1" 140 mesh disc or mesh filter to protect drip irrigation. A water meter, even an inexpensive plastic model, is recommended to monitor use, and detect leaks
-Cross connection with existing property water systems is dangerous to human health unless properly designed and permitted. If the rain tanks run dry, a garden hose can be temporarily used to partially refill the tanks to maintain pump function. If stored water proves insufficient, it is advisable that some of the irrigated area be disconnected from rainwater. Alternate refill from other water supply only recommended with permitted air gap into tank, refilling tank partially to retain most of tank volume for rain capture, or reduced pressure backflow device protecting a potable water irrigation backup
-If pump does not have built-in run-dry protection, install a float switch in tank which interrupts pump power when water level nears outlet
-Pump recommendations: A: Goulds J5S with 45-gallon pressure tank, requires pressure switch and run-dry float switch in tank
B: Grundfos Scala2 with 45-gallon pressure tank, built-in pressure switch and run-dry protection

Setbacks:
-Tanks recommended 3' from buildings or fences for access. No unpermitted modifications to buildings
-Overflow swales and raingardens: recommended 50' from waterways, buildings, wells or septic systems. 10' from buildings if downslope. Closer per engineer