WATER IMPROVEMENT PROJECT PLAN
WESTFALIA KINDERDORF, CIENEGUILLA PERU

Phase 1 of 2
Water Quality, Distribution and Storage Improvements

March 31, 2014

EXECUTIVE SUMMARY

The Aldea Infantil Westfalia Kinderdorf in Cieneguilla Peru[1] has an urgent need to improve the safety and availability of their facility water.

- Residents are physically exposed to a polluted mixture of water from a local river contaminated by fecal waste and an otherwise relatively clean shallow well
- The existing plumbing infrastructure no longer meets the facility needs after two decades of expansion resulting in daily distribution management complications
- The facility has no hydrant-based fire-fighting capability which fails to meet new government requirements

This document addresses Phase 1 of a two-phase project. This phase will make substantive water improvements, eliminate the health risk from polluted water exposure, and can be completed within 8 months of full funding. The cost estimate for Phase 1 is Peruvian Nuevo Soles S/90,000 or approximately 23,500€ or US$32,500.

Phase 2 will involve a transition from fossil fuel based water pumping to solar-electric power in the late-2014/early-2015 timeframe. Phase 2 is only in the preliminary planning stage and is roughly estimated to cost 30,000€ to 40,000€ or US$40,000 to US$60,000.

NARRATIVE

This water improvement project consists of two phases: Phase 1 will improve the safety, availability, and distribution of the facility water, both domestic and agricultural. Phase 2 will transition the water pumping energy source from fossil fuel to solar-electric power.

Currently, the facility pipework distributes a bacteriologically-polluted mixture of water from the highly-polluted often turbid local river and the relatively clean off-site well[2]. Both sources of water are mixed and enter a single network of common-use pipework to both domestic users, livestock and agriculture. The water from the well is clear, significantly cleaner and has the potential of becoming potable with some minor facility improvements. The main problem with the existing infrastructure is that without segregation between

[1] In Google Earth or Google Maps enter: 12 4'35.81"S 76 46'22.69"W to place yourself in the center of the Westfalia Kinderdorf facility.

[2] Refer to Attachment 5, Historical Water Test Reports. The well water is only lightly contaminated, indicated by “other coliforms.” The river however is highly contaminated indicated by e-Coli fecal and “other” coliforms. The facility water test results reflect the mixture of these two water sources as would be expected. The level of contamination represents a significant health risk not only for drinking but tooth-brushing and even bathing. NOTE: The drinking water comes only from the well and is sterilized with a UV treatment system or boiled.

water sources[3], the orphanage residents are in constant contact with significantly-polluted water far exceeding World Health Organization (WHO) standards and plumbing fixtures often leak or fail prematurely due to sediment fouling. This project will rectify this condition by installing an entirely new domestic pipework network separate from the existing pipework which will be reallocated solely to agricultural use.

As a result of this segregation, all domestic-use water will enter a new domestic network sourced only from the off-site well which will provide significantly cleaner and healthier water (possibly becoming potable with improvements) and all agricultural-use water will enter the existing agricultural-only network sourced primarily from the river aqueduct via the cistern.

An additional problem is that the existing network of pipework, after many years of expansion and modification, itself is no longer adequate to meet either the domestic or the agricultural needs in terms of water availability. It is a common occurrence for certain buildings to experience water outage while others do not; and the sequencing of agricultural irrigation zones has to be meticulously managed as water use in one zone can create outage in another due to dynamic pressure losses. These problems will be eliminated with the new segregation plus some minor improvements to the agricultural-only pipework.

Lastly, new government regulations require enhanced hydrant-based fire-fighting capability which is currently nonexistent. The new infrastructure will be configured to meet these new government requirements and provide a robust ability to fight fires throughout the facility.

The cost to execute this first phase is estimated to be Peruvian Nuevo Soles S/90,000 or approximately 23,500€ or US$32,500. The intended Phase 2 of this water improvement project will consist of augmenting the existing diesel-generator-powered high-horsepower electric pumps with lower-rate solar energy pumps with the expectation that normal operations may be entirely solar powered with infrequent need to expend fossil fuel to meet the facility water requirements. Detailed cost analysis has not been accomplished for Phase 2 but a rough-order-of-magnitude estimate falls between 30,000€ to 40,000€ or US$40,000 to US$60,000. The remainder of this document only addresses Phase 1.

PHASE 1 OBJECTIVES

Objective 1: Improve domestic-use water quality and availability.

- Install new distribution network so all domestic water comes from the well
- Install new storage tanks dedicated solely to domestic water storage
- Disinfect well and improve facility to potentially produce potable water

Objective 2: Improve agricultural-use water availability and suitability.

- Reconfigure distribution so all agricultural water comes from the river via the cistern (the well remains a backup source when the river is dry)
- Designate specific storage tanks by elevation to irrigation zones to improve suitability for irrigation, drip and conventional

[3] With one exception: An ultraviolet water sterilization system was placed into operation in May 2012 to provide safe drinking water and the source for this system is exclusively the off-site well.

- Install new pipework and storage to develop West Orchard area
- Improve distribution network to eliminate flow problems and pressure losses
- Install sediment filtration

Objective 3: Improve facility security by providing fire-fighting capability.

- Provide fire hydrants and hose with reach to all buildings (except gatehouse)

Objective 4: Minimize material and labor costs.

- Reutilize existing tanks, pipes and fixtures
- Minimize digging of virgin trenches by un-earthing existing trenches
- Use staff and volunteer workers for labor to the maximum extent possible

ASSUMPTIONS

Average daily water consumption is assumed to be 90m^3/day consisting of 30m^3/day domestic, 35m^3/day agricultural (existing development) and 25m^3/day for the West Orchard (to be developed). Refer to Attachment 7, "*Estimating Projected Facility Water Consumption…*" for the rationale to support these assumptions.

The off-site well is assumed to be capable of producing sufficient water to meet all domestic and agricultural needs in winter when the river aqueduct is dry. That need should be something less than the 90m^3 mentioned above since the agricultural needs would be lower in the off-growing season. Only the subjective opinions of several long-term staff members are available to support this assumption and are based on their observations of the "minor" drop in water level as the well has always historically met all the facility requirements (currently measured at 49m^3/day- summer). Nevertheless, this represents a risk and worst-case mitigation may involve future well improvement as the West Orchard is developed and/or the facility capacity increases.

There is assumed to be no need for external lifecycle support to the improvements made in this Phase 1. The existing staff have the necessary skills and experience to maintain the system throughout its lifecycle. Design consideration has been included to make the infrastructure functions sufficiently intuitive to facilitate any future modifications without degrading the intended function or purpose. The electrical signal circuits are fundamental and can be troubleshot/repaired by any electrician or experienced handyman.

DESIGN AND ENGINEERING

(The following narratives refer to the diagrams in Attachments 1-3)

Domestic Water Tanks:

Three new polyethylene water tanks of 10m^3 each will be installed in the Northeast corner of the facility for a total domestic capacity of 30,000 liters. Water will enter the tanks from the off-site well via new 2 ½" PVC pipe from the East ridgeline until a high-level float valve in the primary tank shuts off flow. At that time, further flow will be diverted through an airgap into the top of a new 5m^3 sequencing tank, identified as TEP05, from which the remaining flow will be sequenced to the various agricultural tanks. The primary domestic tank will have electrical high-level and low-level switches wired to a signal panel near the cistern pumping station and also will be equipped with a visual level indicator to facilitate pump management. There is sufficient available level space at this tank farm location to drastically increase storage capacity in the future simply by adding tanks of compatible dimensions.

Domestic Water Distribution Network:

An entirely new network of pipe will be installed to provide water to each of the facility building service entries. The only existing infrastructure to be reutilized will be the 2” pipe from the well up to the East ridgeline and the pipework and tanks existing within each of the facility buildings.

Agricultural Water Tanks:

The five existing common-use concrete water tanks will be reallocated to agricultural use only and in total they represent approximately 216 m^3 of storage. Three new polyethylene tanks (two $10m^3$ and one $5m^3$) will be installed at the far West edge of the facility to provide irrigation to the West Orchard. The total agricultural storage capacity will then be $241m^3$. The availability of water in the river aqueduct is neither continuous nor predictable and this large degree of storage capacity is important to agricultural water security. The new West Orchard tanks will have electrical high-level switches wired to a signal panel near the cistern pumping station and also be equipped with visual level indicators to facilitate pump management.

Agricultural Water Distribution Network:

The existing common-use network of pipe will be reallocated to agricultural use only. A few improvements will be made to increase flow rates and pressure to areas currently lacking. The most significant improvement however will be the installation of a long 2 ½” gravity-fed main line to the West Orchard tanks. This improvement represents a significant expense and the cost-benefit analysis is shown in Attachment 6, “*West Orchard Main Line Pipe Selection and Configuration*.”

Sequencing Tank, TEP05:

TEP05 will be a new $5m^3$ polyethylene tank located at the highest elevation of all the facility tanks. This tank serves to sequence water flow to the various agricultural tanks in a priority-based scheme regardless of seasonal pump configurations. TEP05 will have an electrical high-level switch wired to a signal panel near the cistern pumping station and also be equipped with a visual level indicator to facilitate pump management.

> *Normal Summer Mode:* Agricultural water comes from the river aqueduct into the CISTERN. It is then pumped into TSC62 (red irrigation zone) which overflows to fill the lower TSC31 (green irrigation zone). Once these two tanks are filled, float valves close to force flow uphill into the top inlet of the sequencing tank, TEP05. The bottom outlet of TEP05 is a gravity fed, approximate 500 meter run of new 2 ½” and 2” PVC pipe to the West Orchard tanks. As TEP05 fills near the top, the next outlet is to TEC15 and TNC02 which irrigate the highest existing agricultural zone (yellow) and supply water to the livestock. As mentioned previously, any excess domestic water flow from the off-site well will also be diverted through an airgap into the top of TEP05. The airgap is a critical design feature to guarantee that contaminated river water can never enter the domestic supply.

Normal Winter Mode: Agricultural water comes primarily[4] from the off-site well since the river is usually dry. The pipework fills the domestic tanks as first priority and then flow is diverted through the airgap into TEP05. The sequencing of water is identical as to the *Normal Summer Mode* case with the exception being that once TEP05 fills to the top, flow then goes out what was normally the inlet from TSC62 and TSC31 to fill these tanks.

Fire-Fighting Capability:

The facility currently has no capability to fight fires other than via hand-held extinguishers. Government regulations are now requiring an enhanced capability and this design provides that with an outdoor fire hydrant station located between Casa 4 and Casa 5. The station will consist of three hydrants- one connected to the West Orchard tank main line; one connected to the domestic water supply; and one connected to the TSC62 line. Assuming full tanks, the West Orchard tank hydrant will provide the highest pressure/flow rate and will have a $20m^3$ capacity. The domestic water supply will be the next capable with a $30m^3$ capacity. The TSC62 line will have the lowest pressure/flow rate and has a $62m^3$ capacity. As each hydrant is exhausted, staff will manually connect the hose to the next hydrant. There will be sufficient hose at this station to reach all the facility buildings (except the distant gatehouse). As soon as possible after fire-fighting begins, one or both of the existing diesel generator-powered pumps would be started to replenish the tanks. Each pump delivers approximately 400L/min which should be sufficient to fight any fire indefinitely.

PROJECT EXECUTION TIMELINE

The timeline of this Phase 1 project is dependent on available finances and willing and available volunteer labor. Given a fully-funded start date, it is feasible that supplies could be procured and delivered within 30 days. It is also feasible that volunteer labor could react within 60 days to accomplish the majority of the labor within another 60 days. The more technically demanding elements may require an additional 120 days. Under these assumptions, this project should be able to be completed within 8 months of full funding.

FINANCIAL MANAGEMENT

Any individual or group donors to this project are expected to indicate their requirements and standards of financial accountability to include naming which individual(s) will be authorized to access and expend funds. To facilitate accountability and efficiency, it is desired to name the Westfalia Director and the Project Manager as authorized individuals.

The Project Manager will monitor project progress and track all fund balances, expenditures, and scan/log all receipts. The accounting log and copies of receipts will be made available (electronically) to any stakeholder upon request.

[4] Water may also be released, occasionally, into the aqueduct during the winter from an upriver reservoir. This is the case in which having excess agricultural storage capacity is a significant contributor to water security.

At the end of the project, the Project Manager will prepare and distribute a comprehensive report which will include the project's end-state, the accounting log and copies of all receipts.

Unless otherwise indicated by the donors, any excess funds will be placed in escrow under the oversight of the Director to be applied to the project's Phase 2. If any donor(s) wish their portion of the excess to be returned, a "percentage-in", "percentage-out" rule will be applied to determine the amount to be returned.

KEY PERSONNEL

President, Internationaler Verband Westfälischer Kinderdörfer: Christel Zumdieck

Director, Westfalia Kinderdorf Peru: Liselotte Schrader

Director of Operations, Westfalia Kinderdorf Peru: Hibo Solórzano

Project Manager & Engineer: Randy Nelson

Management Support & Translation: Scott Jeppesen

Accounting: Yuko Nelson

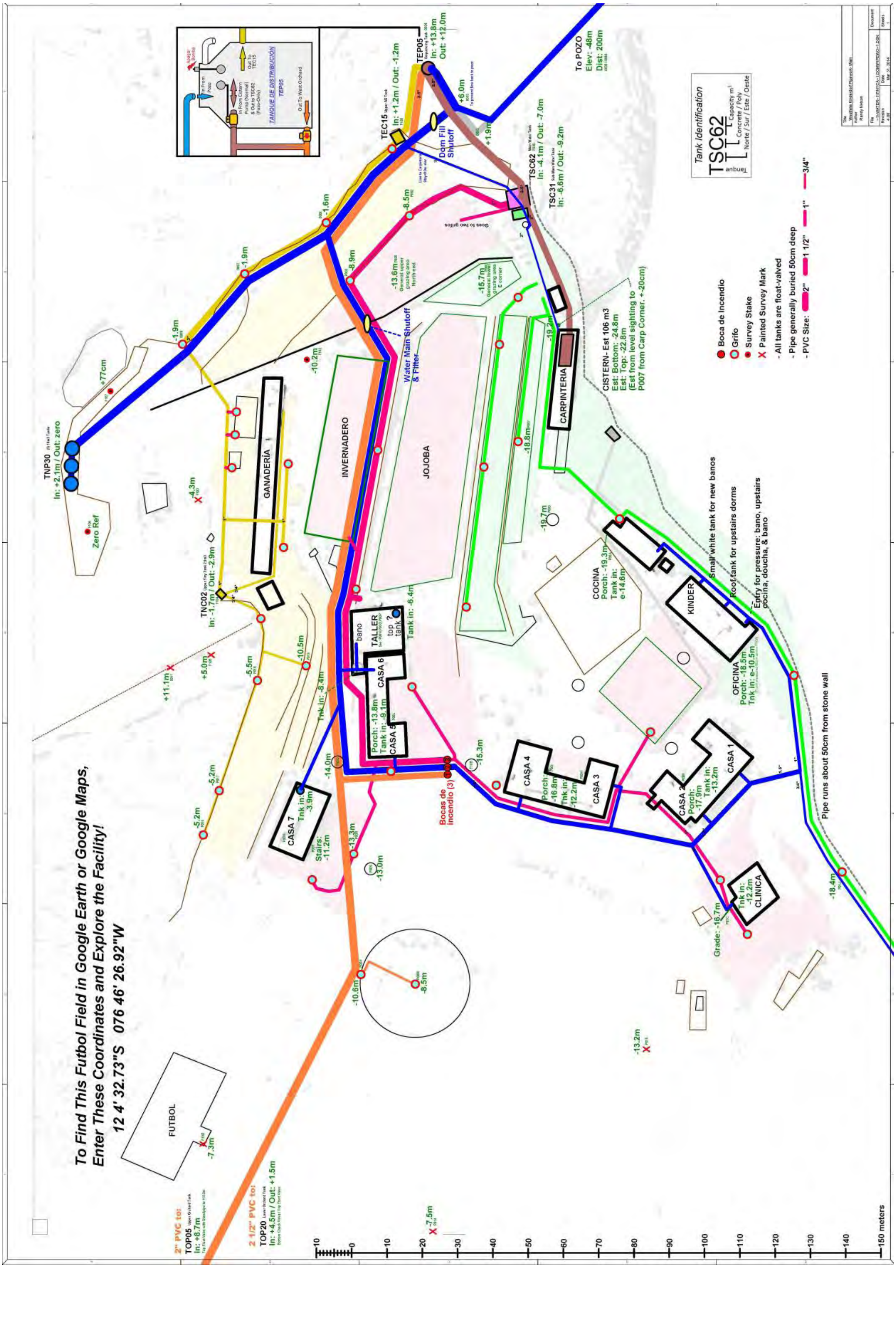
INDEX TO ATTACHMENTS

1. Pipework Diagram- Main
2. Pipework Diagram- West Orchard
3. Pipework Diagram- Gatehouse
4. Cost Analysis
5. Historical Water Test Reports
6. West Orchard Main Line Pipe Selection and Configuration
7. Estimating Projected Facility Water Consumption by Application- Domestic, Agricultural (current), and West Orchard

PROPIETARIO: WESTFALIA KINDERDORF	LAMINA: N/A
OBRA: MEJORAS DE AGUA, FASE 1	
UBICACION: CIENEGUILLA KM 27.5	
ID: *Facility Improvement Project Plan Phase 1*	#: *N/A*
ESCALA: *N/A*	PLANO: *Documento*
REALIZADO POR: *RANDALL NELSON* *RANDYUKO@HOTMAIL.COM*	ESPECIALIDAD: *Ingeniería Mecánica (EE.UU.)*
FECHA: *31/03/2014*	VERSIÓN: *1.0*
Original report text in English.	

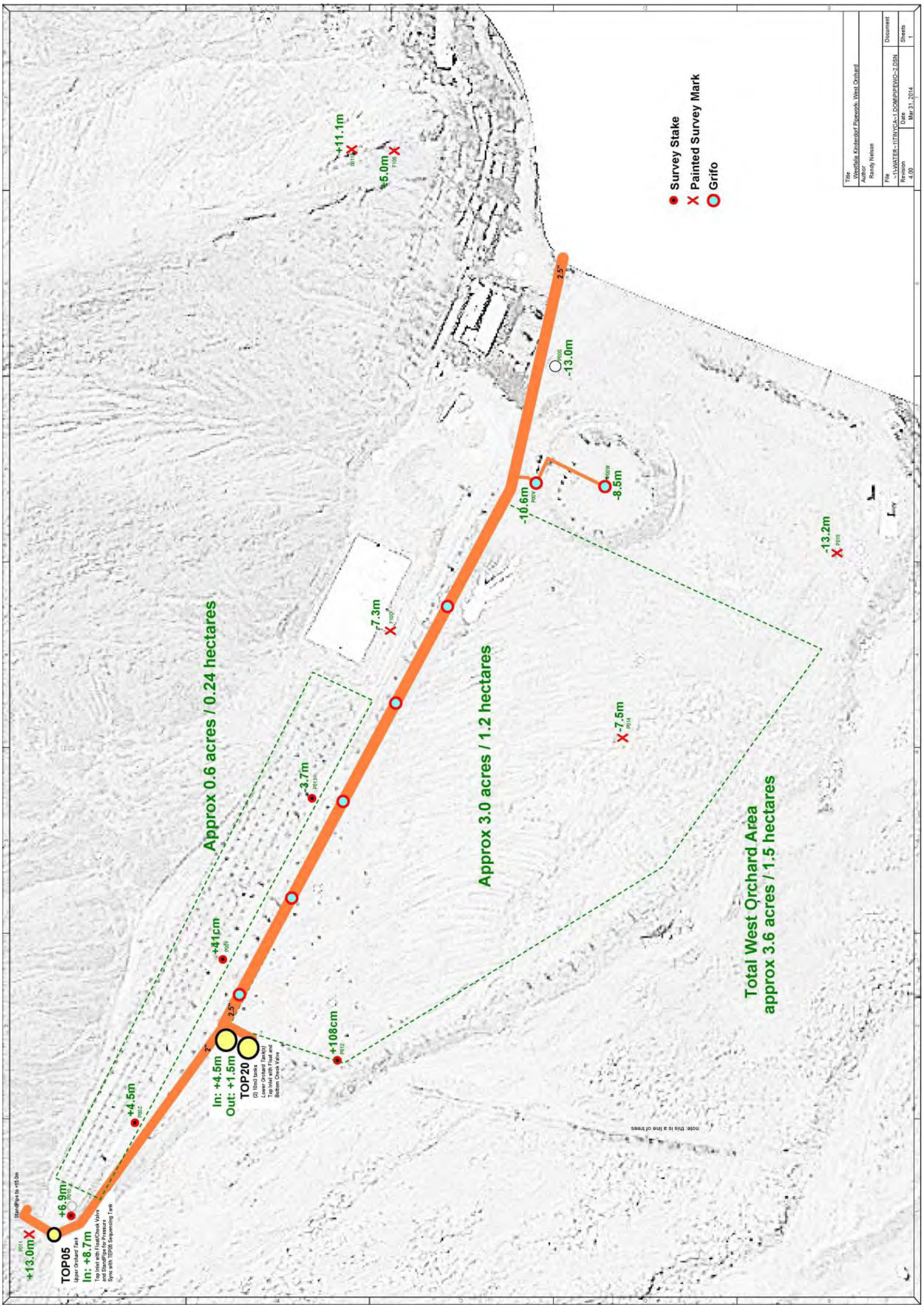
Attachment 1

Pipework Diagram- Main



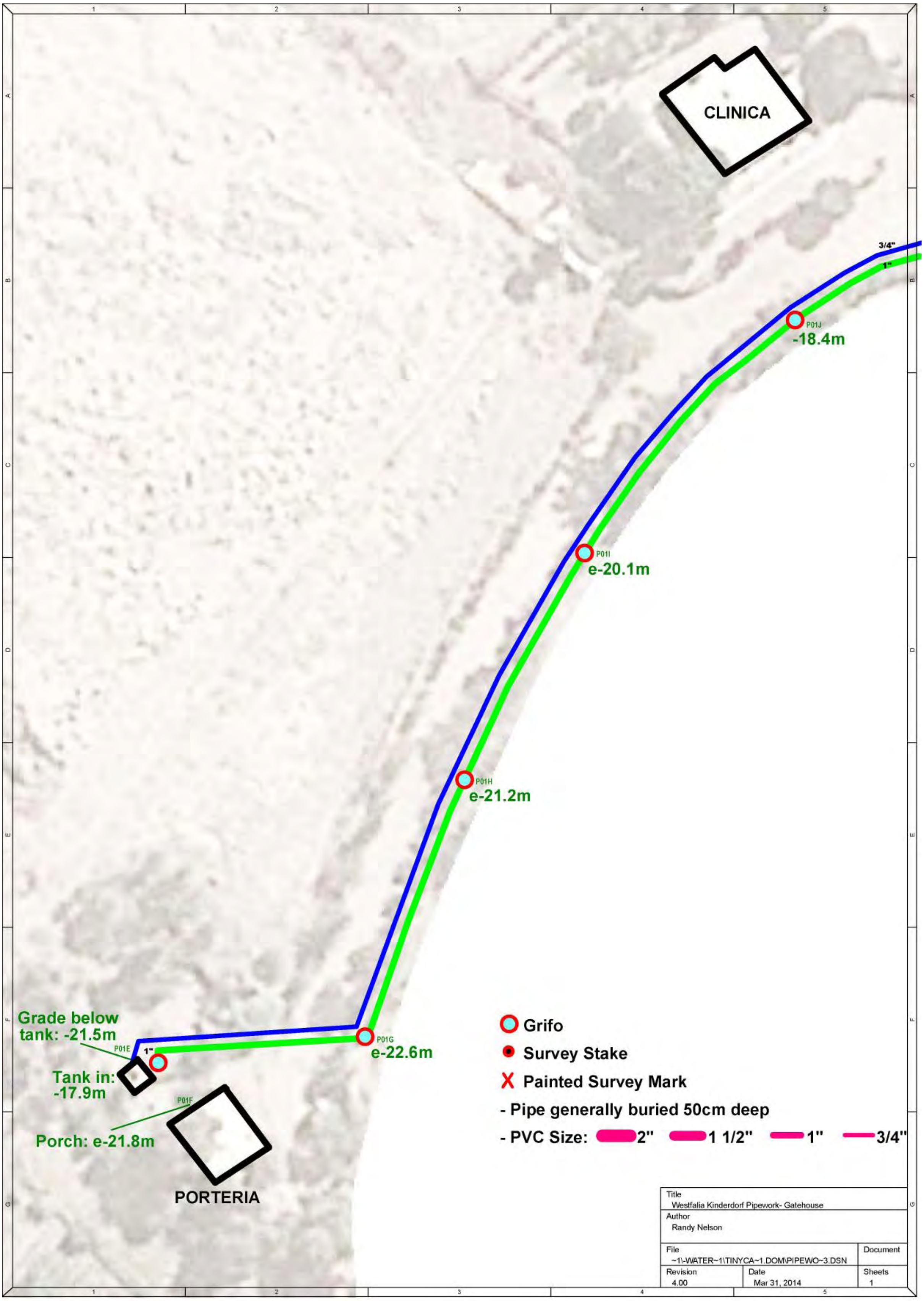
Attachment 2

Pipework Diagram- West Orchard



Attachment 3

Pipework Diagram- Gatehouse



Attachment 4

Cost Analysis

<u>Narrative</u>

The following itemized cost breakdown is organized by basic component type (tanks, pipe, fittings, etc.) and represents a survey of actual local retail prices during the latter half of 2013 and into 2014. There is significant risk in cost estimating due to both currency exchange fluctuations and retail price fluctuations. For this reason, the final estimates for each component are increased 20% as indicated in the tables. The final two columns reflect these costs in Euros and US Dollars at current exchange rates of 0.26 and 0.36 respectfully.

The cost analysis consists entirely of tangible costs (except for estimated delivery fees) since labor for this project is assumed to consist of existing staff and unpaid volunteers. The primary cost drivers are the new tanks.

<u>The estimated cost of this Phase 1 project is: S/.90,000 or 23,500€ or US$32,500</u> (values rounded up to nearest 500).

<u>Itemized Cost Breakdown</u>

TANKS						
Description	Qty	Soles Each	Soles Total	120% Total	Euros Total	Dollars Total
10,000 liter polyethylene tank (Rotoplas)	5	S/. 7,400	S/. 37,000	S/. 44,400	11,544 €	$15,984
5,000 liter polyethylene tank (Rotoplas)	2	S/. 3,200	S/. 6,400	S/. 7,680	1,997 €	$2,765
Tank Delivery			S/. 2,000	S/. 2,400	624 €	$864
		TOTAL:	S/. 45,400	S/. 54,480	14,165 €	$19,613

PIPE						
Description	Qty	Soles Each	Soles Total	120% Total	Euros Total	Dollars Total
2 ½" Class 10 PVC, 5m lengths	142	S/. 62	S/. 8,804	S/. 10,565	2,747 €	$3,803
2" Class 10 PVC, 5m lengths	90	S/. 43	S/. 3,870	S/. 4,644	1,207 €	$1,672
1 ½" Class 10 PVC, 5m lengths	24	S/. 25	S/. 600	S/. 720	187 €	$259
1" Class 10 PVC, 5m lengths	47	S/. 15	S/. 705	S/. 846	220 €	$305
3/4" Class 10 PVC, 5m lengths	53	S/. 10	S/. 530	S/. 636	165 €	$229
Pipe delivery			S/. 1,000	S/. 1,200	312 €	$432
		TOTAL:	S/. 15,509	S/. 18,611	4,839 €	$6,700

PIPE FITTINGS & COMPONENTS						
Description	Qty	Soles Each	Soles Total	120% Total	Euros Total	Dollars Total
2" Fire Hydrant to 1 1/2" hose	3	S/. 145	S/. 435	S/. 522	136 €	$188
2" Metal Hydrant riser- 36"	3	S/. 25	S/. 75	S/. 90	23 €	$32
2 1/2" Float Valve	3	S/. 631	S/. 1,893	S/. 2,272	591 €	$818
2" Float Valve	2	S/. 310	S/. 620	S/. 744	193 €	$268

1" Float Valve	1	S/. 90	S/. 90	S/. 108	28 €	$39
2" Water Meter	3	S/. 465	S/. 1,395	S/. 1,674	435 €	$603
2 1/2" Check Valve	1	S/. 260	S/. 260	S/. 312	81 €	$112
2" Check Valve	2	S/. 145	S/. 290	S/. 348	90 €	$125
2 1/2" Ball Valve	3	S/. 195	S/. 585	S/. 702	183 €	$253
2" Ball Valve	9	S/. 125	S/. 1,125	S/. 1,350	351 €	$486
1" Ball Valve	15	S/. 33	S/. 495	S/. 594	154 €	$214
3/4" Ball Valve	2	S/. 20	S/. 40	S/. 48	12 €	$17
2 1/2" Tee	16	S/. 18	S/. 288	S/. 346	90 €	$124
2 1/2" Elbows	9	S/. 14	S/. 126	S/. 151	39 €	$54
2 1/2" 45deg Elbows	6	S/. 14	S/. 84	S/. 101	26 €	$36
2 1/2" Threaded Nipples x 8"	1	S/. 13	S/. 13	S/. 16	4 €	$6
2 1/2" Threaded Nipples x 3"	1	S/. 11	S/. 11	S/. 13	3 €	$5
2 1/2" Threaded Male to Slip	3	S/. 14	S/. 42	S/. 50	13 €	$18
2" Tee	13	S/. 9	S/. 117	S/. 140	37 €	$51
2" Elbows	12	S/. 8	S/. 96	S/. 115	30 €	$41
2" 45deg Elbows	7	S/. 8	S/. 56	S/. 67	17 €	$24
2" Threaded Nipples x 8"	5	S/. 10	S/. 50	S/. 60	16 €	$22
2" Threaded Nipples x 3"	8	S/. 8	S/. 64	S/. 77	20 €	$28
2" Threaded Male to Slip	2	S/. 11	S/. 22	S/. 26	7 €	$10
1 1/2" Tee	7	S/. 7	S/. 49	S/. 59	15 €	$21
1 1/2" 45deg Elbows	2	S/. 7	S/. 14	S/. 17	4 €	$6
1" Tee	4	S/. 4	S/. 16	S/. 19	5 €	$7
1" Elbows	16	S/. 3	S/. 48	S/. 58	15 €	$21
1" 45deg Elbows	28	S/. 4	S/. 112	S/. 134	35 €	$48
1" Couplings	5	S/. 3	S/. 15	S/. 18	5 €	$6
1" Threaded Nipples x 6"	15	S/. 4	S/. 60	S/. 72	19 €	$26
3/4" Elbows	8	S/. 3	S/. 24	S/. 29	7 €	$10
3/4" 45deg Elbows	2	S/. 3	S/. 6	S/. 7	2 €	$3
Reductions: 2 1/2" to 2"	7	S/. 7	S/. 49	S/. 59	15 €	$21
Reductions: 2 1/2" to 1"	8	S/. 7	S/. 56	S/. 67	17 €	$24
Reductions: 2" to 1"	7	S/. 5	S/. 35	S/. 42	11 €	$15
Reductions: 1 1/2" to 1"	8	S/. 4	S/. 32	S/. 38	10 €	$14
Reductions: 1" to 3/4"	1	S/. 3	S/. 3	S/. 4	1 €	$1
Reductions: 3/4" to 1/2"	1	S/. 2	S/. 2	S/. 2	1 €	$1
Tank Bungs: 2 1/2"	3	S/. 38	S/. 114	S/. 137	36 €	$49
Tank Bungs: 2"	7	S/. 20	S/. 140	S/. 168	44 €	$60
		TOTAL:	S/. 9,047	S/. 10,856	2,823 €	$3,908

MISCELLANEOUS						
Description	Qty	Soles Each	Soles Total	120% Total	Euros Total	Dollars Total
2" Water Filters	4	S/. 90	S/. 360	S/. 432	112 €	$156
Fire Hose- 1 1/2" x 30m	5	S/. 250	S/. 1,250	S/. 1,500	390 €	$540
Tank Level Switches	5	S/. 55	S/. 275	S/. 330	86 €	$119
4 Cond Phone Wire- 150m rolls	6	S/. 175	S/. 1,050	S/. 1,260	328 €	$454
PVC Cement- 32oz cans	10	S/. 35	S/. 350	S/. 420	109 €	$151
Teflon Pipe Thread Tape- rolls	40	S/. 3	S/. 120	S/. 144	37 €	$52

Spray Paint- Orange	5	S/. 10	S/. 50	S/. 60	16 €	$22
Spray Paint- Blue	20	S/. 10	S/. 200	S/. 240	62 €	$86
Shovels	5	S/. 35	S/. 175	S/. 210	55 €	$76
Pickaxes	3	S/. 42	S/. 126	S/. 151	39 €	$54
PKG: Tools to safely winch TEP05 uphill: Cable, rope, hand winch, pulleys, lumber, stakes, etc.	1	S/. 500	S/. 500	S/. 600	156 €	$216
PKG: Tank Status Light Board (homemade): Wood, paint, LEDs, mount, etc.	1	S/. 150	S/. 150	S/. 180	47 €	$65
PKG: Visual Tank Level Indicators: Cable, bicycle wheel, bracket, float, target, hardware, etc.	4	S/. 100	S/. 400	S/. 480	125 €	$173
		TOTAL:	S/. 5,006	S/. 6,007	1,562 €	$2,163

TOTALS			
Pipe:	S/. 18,611	4,839 €	$6,700
Pipe Fittings & Components:	S/. 10,856	2,823 €	$3,908
Tanks:	S/. 54,480	14,165 €	$19,613
Miscellaneous:	S/. 6,007	1,562 €	$2,163
GRAND TOTAL:	**S/. 89,954**	**23,388 €**	**$32,384**

Attachment 7

Estimating Projected Facility Water Consumption by Application
Domestic, Agricultural (current), and West Orchard

Introduction

The requirement is to estimate projected facility water consumption to ensure the project design will meet current and likely future water needs. Individual estimates are required for domestic needs, existing agricultural needs (on-site needs only, not to include the off-site farm), and the future West Orchard expansion.

Estimating water consumption is extremely problematic due to a lack of historical data. The only available datapoint is a calculated estimate of $49m^3$/day total water consumption (domestic and agricultural) derived from generator operating hours (equivalent to pump operating hours) over the period Nov 2013 to Mar 2014. These data reflect a summer period with approximately 20 adults and 100 children. This phase 1 project design aims to provide for a potential facility expansion to care for handicapped children which would essentially double the population.

Domestic Consumption Estimate

Narrative: Estimate domestic water consumption by two methods- analysis of local historical data and application of UN social statistics.

Analysis 1: Mathematically round current consumption of $49m^3$/day to $50m^3$/day and apply a "rule of thumb" hypothesis that 20% is domestic ($10m^3$) and 80% agricultural ($40m^3$) justified solely by observation of local practices. The agricultural consumption is not expected to increase but domestic may double which yields a projected domestic consumption estimate of $20m^3$/day.

Analysis 2: A 2006 United Nations source[1] estimates average per capita water consumption in Peru of 175L/day. At the current facility population, this data would suggest a total daily domestic consumption of $21m^3$/day. Relative to the known current total consumption of $49m^3$/day this UN value seems to be excessive since it appears intuitively obvious that a significant majority of the $49m^3$/day water consumption is expended on the agriculture. This phase 1 project aims to provide for 40 adults and 200 children which by applying this analysis would then yield a domestic consumption of $42m^3$/day.

Conclusion: Hypothesize $30m^3$ per day projected domestic water consumption by averaging the two analyses (therefore current domestic consumption is assumed to be $15m^3$/day).

Existing Agriculture Consumption Estimate

Narrative: The hypothesis in the domestic water consumption section above concluded that the current domestic water consumption is $15m^3$/day. In light of this hypothesis, the

[1] United Nations Development Programme (UNDP) Human Development Report 2006. Accessed online on 03/19/2014 at: http://hdr.undp.org/en/content/human-development-report-2006

estimated current agricultural water consumption is $35m^3$/day ($50m^3$/day – $15m^3$/day). The agricultural consumption (not to include the West Orchard) is not projected to increase.

West Orchard Consumption Estimate

Narrative: Estimate West Orchard water requirements by two methods- a common generic USA fruit tree density for typical orchards and a formal California, USA study[2] growing the Andean fruit Cherimoya.

There are currently approximately 0.24 hectares planted with fruit trees along the north side of the West Orchard road and another 1.22 hectares to be developed south of the road for a total of 1.46 hectares (3.6 acres) to be irrigated via drip irrigation. The cost and installation of the drip irrigation equipment is not included in this project.

Analysis 1: Applying a generic estimate based on typical USA fruit tree orchard density of 500 trees for 3.6 acres at 15 gal/day/tree yields $28m^3$/day consumption.

Analysis 2: California (USA) Cherimoya fruit orchard study: 134 trees/acre needing 2 acre-feet/acre/year yields $24m^3$ per day consumption. Calculations: 482 trees (134 trees/acre x 3.6 acres). 2 acre-feet = $2{,}466m^3$. $2{,}466m^3$/year = 6.76 m^3/day. Therefore 6.76 m^3/day x 3.6 acres = $24m^3$/day

Conclusion: Split the difference between both analyses and round to $25m^3$ per day projected West Orchard consumption.

Conclusions

Total water consumption is projected to be $90m^3$/day for the facility. This consists of a domestic consumption projection at double the current population of 30m3/day plus agricultural consumption of 35m3/day plus projected West Orchard consumption of 25m3/day. This does not include the water requirements at Westfalia's off-site farm which is satisfactorily irrigated via other means and is not included in this project.

[2] Undated Document: "Can You Make Money Growing Cherimoya in the Coastal Regions of California? A Sample of Establishment and Production Costs and Profitability Analysis, Etaferahu Takele, University of California, Area Farm Advisor, Riverside County". Accessed online on 03/19/2014 on: http://ucanr.org/sites/farm_management/files/108128.pdf