TECHNICAL MEMORANDUM

MWH

BUILDING A BETTER WORLD

To:	Marcus Fuller, City of Palm Springs	**Date:**	05/29/2015
From:	Michael Adelman, Miko Aivazian, Tyler Hadacek, Jim Borchardt, Randy Lovan	**Reference:**	Job No. 10507240
Subject:	Headworks and Primary Clarifier Upgrade Constructability Review Hydraulic Profile Options and Cost Estimates		

INTRODUCTION

The headworks and primary clarifiers are to be upgraded at the Palm Springs Wastewater Treatment Plant (WWTP). The current design for this upgrade project calls for an Influent Pump Station (IPS) to convey flow from the headworks to the primary clarifiers.

This memo presents the available hydraulic profile options for the WWTP, both with and without the IPS. Option 1 (the current design) places the primary clarifiers mostly above grade and requires the IPS. Option 2 (a design alternative) lowers the clarifier bottoms and conveys flow from the headworks to the existing Primary Effluent Pump Station (PEPS) by gravity and does not require the IPS. Option 3 (another design alternative) is similar to Option 2, but with one larger clarifier instead of two, which reduces construction cost but sacrifices redundancy.

OPTION 1 – WITH INFLUENT PUMP STATION (IPS)

Option 1 Hydraulic Profile

The objectives of the current hydraulic profile design are to lower the water level in the influent sewer; and construct the primary clarifiers above grade. The first objective is important to avoid surge issues upstream – at the average plant flow of 10.9 mgd, the hydraulic grade line at the existing headworks is above the 42" influent sewer pipe, causing this pipe to pressurize.

The hydraulic profile associated with Option 1 is tabulated in **Attachment 1** and illustrated in **Attachment 2**. The flowpath in Option 1 includes the elements listed below. Hydraulic grade line (HGL) elevations are reported in feet above mean sea level for the average plant capacity of

10.9 mgd plus 2 mgd recycle, assuming one bar screen channel and one clarifier online. The HGL is also shown for peak flow in **Attachment 1** with both channels and clarifiers online.

1. Water enters the headworks through the ***Influent Sewer***, where the HGL elevation at the sewer exit will be about El. 356 ft. This allows for open channel flow in this sewer.

2. Water exits the Influent Sewer into a ***Parshall Flume***, which measures the plant flow rate. The headloss across this 24" Parshall Flume will be about 1.6-ft at average flow.

3. From the flume, the water exits over an ***Exit Weir*** with its crest at El. 353.33 ft. This weir is only 3 ft wide and will have a head loss of about 1.4-ft. This Exit Weir sets the water level in the Influent Sewer, and placing it at the proposed elevation prevents the Influent Sewer from surcharging.

4. After water flows over the Exit Weir, it enters the ***Bar Screen Channels***. There are two parallel Bar Screen Channels and one bypass channels, all of which share a common influent box. Each channel has an influent gate and an outlet gate. At the influent end, the water elevation will be around El. 352.5 ft, which allows for some freeboard space below the Exit Weir.

5. The major headloss elements in the Bar Screen Channels are the ***Bar Screens***. With one bar screen channel online, the headloss across the screen will be around 1.3-ft, and the water level in the channel downstream will be around El. 351.3 ft.

6. Water exits the Bar Screen Channels into the ***Influent Pump Station Wet Well***. There are two wet wells sharing a common influent box, and water passes through a gate and baffle wall to enter each wet well. The operating water surface elevation in the wet well is El. 351.25 ft. The recycle flow also enters here, to be conveyed to the clarifiers.

7. From the wet well, the ***Influent Pumps*** convey water to the Primary Clarifiers through a 36" pipeline. Assuming one clarifier offline, providing the full plant flow to the farther clarifier (through about 310-ft of pipe) requires the pumps to provide 22-ft of head.

8. Water flows through the 100-ft diameter ***Primary Clarifiers***, and exits over the weir with a crest at El. 370 ft. The water depth in the proposed clarifiers is over 16-ft.

Clearly, meeting the design objectives of Option 1 requires the construction of the IPS as designed. The proposed elevation of the clarifier weir indicates that some kind of lift is required for flow to get through the clarifiers, given the much lower HGL elevation in the influent sewer and the requirement to keep this elevation low enough to prevent the sewer from surcharging.

Option 1 Implications

This option has the following advantages:

- *Clarifier constructability.* The clarifiers will be mostly above grade, which reduces the costs associated with earthwork and shoring.

- *Clarifier access.* Operator access to the clarifiers will be straightforward via an above-grade external walkway and bridge.
- *Clarifier performance.* When sized as shown in the current design, the clarifiers have an overflow rate of 821 gal/ft^2-day and a detention time of 2.7 hours at average flow, and a 1528 gal/ft^2-day overflow rate at peak flow (**Attachment 3**). These are both within the typical design range for primary clarifiers. They are expected to achieve good suspended solids removal, and the large depth and long detention time provide operational flexibility to avoid sludge overflow.

The advantages associated with this option come at the following costs:

- *IPS capital costs.* Because the IPS is required for this option, there would be capital costs to construct the wet well for this pump station; and to furnish the required equipment, including four vertical-turbine pumps complete with plug and check valves.
- *Operation and maintenance costs.* Running the IPS continuously would increase the power cost of the plant. Adding a pump station to a treatment plant also increases the maintenance costs because of the equipment wear and tear.

OPTION 2 – WITHOUT INFLUENT PUMP STATION

Option 2 Hydraulic Profile

In this design alternative, the clarifiers are placed at a lower elevation (constructed deeper into the ground), while keeping other features of the headworks the same. This option has two major objectives:

1. Preventing surcharge of the influent sewer (same as Option 1)
2. Convey flow through primary clarifies all the way through Primary Effluent Pump Station (PEPS) by gravity

This second objective would eliminate the need for an IPS upstream of the primary clarifiers.

The hydraulic profile associated with Option 2 is tabulated in **Attachment 4** and illustrated in **Attachment 5**. The flowpath for this option, starting from the Bar Screen Channel, is described below. Note that the profile from the Influent Sewer to the Parshall Flume Exit Weir (Steps 1-3) for this option is the same as in Option 1, because these elevations are set by the Exit Weir.

4. After water flows over the Exit Weir, it enters the ***Bar Screen Channels***. At the influent end, the water elevation will be around El. 353.1 ft, which just avoids overtopping the Exit Weir.

5. The major headloss elements in the Bar Screen Channels are the ***Bar Screens***. With one bar screen channel online, the headloss across the screen will be around 0.6-ft, and the water level in the channel downstream will be around El. 352.5 ft. The headloss through the bar screens is reduced compared to Option 1 because the water in the Bar Screen Channel is deeper, and the velocity through the bar screen is therefore lower.

6. Water exits the Bar Screen Channels into a ***Splitter Box,*** which replaces Influent Pump Station Wet Well from Option 1. Flow enters this Splitter Box from the two Bar Screen Channels and the Recycle lines. From the Splitter Box, water flows to the Primary Clarifiers through a 36" pipeline. Assuming one clarifier offline, the headloss through this piping will be approximately 1-ft.

7. Water flows through the ***Primary Clarifiers***, and exits over the clarifier weir with a crest elevation of 351.5 ft. Note that if the clarifier weir were any higher than this elevation, the Exit Weir of the Parshall Flume would be overtopped, backing up the water in the Influent Sewer. The clarifiers in this option are proposed to be 9-ft deep.

8. From the Primary Clarifiers, water must flow to the existing ***Primary Effluent Pump Station Wet Well*** by gravity. The flowpath to the PEPS consists of 42", 36", and 48" piping, with a total headloss around 0.7-ft at average flow. The current operating water level in this wet well is between El. 352 and El. 354.5 ft, and this level must be reduced to around El. 350 ft to avoid overtopping of the primary clarifier weirs.

Option 2 Implications

The major advantage of this option is the elimination of the need for the IPS from the design. This will avoid the construction cost of the IPS wet well, and the equipment purchase cost of the pumps,valves and electrical/control systems. The power and maintenance costs for the IPSwould also be avoided, and gravity-flow processes are inherently easier to maintain than processes relying on pump stations.

The advantages of eliminating the IPS come with some costs:

- *Increased clarifier construction cost.* Significant additional earthwork and shoring would be required to construct the new clarifiers with a weir elevation of 351.5 ft, which is 18.5 ft below the current design. If the clarifiers in this option are 9-ft deep, the bottom of the clarifier tank will be approximately 11-ft lower than the current design.
- *More difficult clarifier access.* With the clarifier weir significantly below grade, access to the clarifiers will be more difficult. An external access platform is no longer possible, and operator entrance to the clarifiers might require confined space entry. Access to the clarifiers in this option will be similar to the existing below-grade clarifiers.
- *Clarifier operational flexibility.* Because solids removal by clarifiers depends primarily on upflow velocity, clarifier performance will be similar to Option 1 (**Attachment 6**). The reduced depth of the clarifiers will affect operational flexibility: the operators would have to pay close attention to the sludge level in the clarifier to avoid excessive buildup of solids, and the shorter detention time (around 2 hr at average flow) makes these shallower clarifiers less forgiving compared to Option 1. However, the clarifiers in this option will still have better operational flexibility than the existing clarifiers, which are less than 7-ft deep.

In addition, the primary effluent pumps would have to provide an additional 2-ft of lift. The ability of the existing pumps to provide this would have to be verified for this option.

OPTION 3 – SINGLE CLARIFIER

Option 3 Hydraulic Profile

In this design alternative, the clarifier weir is placed at a lower elevation and flow is conveyed to the PEPS entirely by gravity, as in Option 2. However, in this alternative, the two 100-ft diameter clarifiers are replaced by a single 120-ft diameter clarifier.

The hydraulic profile associated with Option 3 is tabulated in **Attachment 4,** along with the Option 2 hydraulic profile. The flowpath and associated HGL elevations are the same for this option as in Option 2, except that the piping to and from the Primary Clarifier is upsized to 48". This larger pipe prevents water from overtopping the Parshall Flume Exit Weir and the Primary Clarifier Weir at peak flow.

Option 3 Implications

This option would allow for significant reduction in construction cost. In addition to the savings from eliminating the IPS (as in Option 2), this option significantly reduces the cost of earthwork, shoring, concrete work, and mechanical equipment by eliminating one clarifier. Savings would be realized even with larger 48" diameter yard piping. The footprint of the headworks and primary treatment would also be substantially reduced (**Attachment 7**).

The average overflow rate (1141 gal/ft^2-day) and peak overflow rate (2122 gal/ft^2-day) of this single clarifier are within the typical design range for primary clarifiers (**Attachment 8**). This means that typical solids removal performance should be achieved. At 9-ft water depth, the clarifier in this option would be even less operationally forgiving than Option 1, because the detention time will be shorter – but it will still be an improvement over the very shallow existing clarifiers. Extending the detention time in this option would require a deeper clarifier, e.g. 13-ft water depth for a 2 hour detention time.

This option has some of the same disadvantages as Option 2 in terms of the required earthwork for below-grade clarifier construction; and the relative difficulty of access compared to above-grade clarifiers. It also creates a lack of redundancy for the primary treatment process. Because the plant must operate continuously, a bypass line around the single clarifier would be required, and the trickling filters would have to handle water of much poorer quality when the clarifier is offline. Taking the clarifier offline also creates a risk of grit accumulation in the anaerobic digesters, as some settleable solids that would have been removed by primary treatment instead continue into the plant.

OTHER POSSIBLE DESIGN MODIFICATIONS

The options defined above vary only the elevation and sizing of clarifiers; and the presence or absence of the IPS. Beyond these factors, there are other elements of the design that could be modified and improved to reduce headloss between the influent sewer and the PEPS.

Some additional possible design modifications include:

- *Wider Parshall flume*. The current design calls for a 24" wide Parshall flume. Using a wider flume would decrease the headloss.
- *Alternative flow measuring device*. The current design calls for both a Parhsall flume and an exit weir to separate the flume from the bar screen channels. Together, these elements account for about 3-ft of headloss at average flow. An alternative flow measuring device (e.g. a V-notch weir with a level transmitter) could perform the plant flow measuring function with a lower headloss.

COST ESTIMATES

MWH has prepared an Opinion of Probable Construction Cost (OPCC) for each option described above. The OPCC encompasses all work on the headworks and clarifiers for each option, and includes a 10% contingency. OPCC calculations are shown in **Attachment 9**.

The OPCC for each option is:

- *Option 1:* $17.1 million
- *Option 2:* $14.3 million
- *Option 3:* $12.3 million

Option 2 appears to offer the best value, as the increased shoring and excavation costs for the below-grade clarifiers is more than offset by the savings from eliminating the IPS. This option also provides redundancy to improve the reliability of the primary treatment process, at a relatively low cost increase over Option 3.

ATTACHMENTS

1. Option 1 Hydraulic Profile Calculations
2. Option 1 Hydraulic Profile Drawing
3. Option 1 Clarifier Sizing
4. Option 2-3 Hydraulic Profile Calculations
5. Option 2-3 Hydraulic Profile Drawing
6. Option 2 Clarifier Sizing
7. Option 3 Site Layout
8. Option 3 Clarifier Sizing
9. OPCC Calculations

Attachment 1
Option 1 Hydraulic Profile Calculations

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 1 - With Influent Pump Station - Average Flow

Calc By: MJA
Chkd: _____

		Flow (MGD)	FLOW PATH CHARACTERISTICS				HYDRAULIC CALCULATIONS							ELEVATIONS (ft AMSL)			
			Diameter (in)	Width (ft)	Length (ft)	K Value	Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	**Total HL (ft)**	**Pump Head (ft)**	HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**356.39**	**357.44**	**353.94**	**2.45**
2	Sewer Pipe exit	10.9	**42**			0.3	7.12	2.37		0.00	0.03	**0.03**		356.37		353.94	2.43
3	Parshall Flume	10.9		**2**			2.34	7.22		0.00	1.62	**1.62**		354.75		353.58	1.17
4	Exit weir	10.9			**3**		4.25	3.97		0.00	1.42	**1.42**		354.75	353.33		1.42
5	Bar Screen Channel Inlet Area													**352.62**	**362.50**	**348.86**	**3.76**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	11.7	1.44	10.8	0.002	0.03	**0.03**		352.58		348.68	3.90
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	18.0	0.94	12.5	0.000	0.00	**0.00**		352.58		348.59	3.99
8	Bar Screen	10.9		**2.5**			7.1	2.38		0.000	1.26	**1.26**		351.33		348.59	2.74
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	9.3	1.82	9.2	0.003	0.06	**0.06**		351.27		348.18	3.09
10	Wet Well Inlet Area													**351.27**	**362.50**	**343.59**	**7.68**
11	Baffle Wall	10.9					24.0	0.70		0.00	0.02	**0.02**		351.25		340.25	11.00
12	Influent Pump Station Wet Well													**351.25**	**362.50**	**340.25**	**11.00**
13	Pump suction piping	12.9	**24**		**25.4**	0.5	3.14	6.35		0.13	0.31	**0.44**					
14	Influent Pump	12.9											**22.2**				
15	Pump discharge piping	12.9	**24**		**21.2**	3.3	3.14	6.35		0.11	2.04	**2.14**					
16	Piping to Primary Clarifier	12.9	**36**		**310**	5.0	7.07	2.82		0.22	0.62	**0.83**					
17	Primary Clarifier	12.9			**314**						0.07	**0.07**		**370.07**	**370.00**	**353.52**	**16.55**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width
24	ft^2	Baffle Wall Open Area

Operating Condition

1		**Bar Screen Channels**
1		**Pumps Online**
10.9	mgd	**Plant Flow Rate**
2.0	mgd	**Recycle Flow Rate**

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 1 - With Influent Pump Station - Peak Flow

Calc By: MJA
Chkd: _____

		Flow (MGD)	FLOW PATH CHARACTERISTICS				HYDRAULIC CALCULATIONS							ELEVATIONS (ft AMSL)			
			Diameter (in)	Width (ft)	Length (ft)	K Value	Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	**Total HL (ft)**	**Pump Head (ft)**	HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**358.17**	**357.44**	**353.94**	**4.23**
2	Sewer Pipe exit	21.8	**42**			0.3	9.62	3.51		0.00	0.06	**0.06**		358.11		353.94	4.17
3	Parshall Flume	21.8		**2**			4.00	8.43		0.00	2.53	**2.53**		355.58		353.58	2.00
4	Exit weir	21.8			**3**		6.75	5.00		0.00	2.25	**2.25**		355.58	353.33		2.25
5	Bar Screen Channel Inlet Area													**352.62**	**362.50**	**348.86**	**3.76**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	11.7	1.44	10.8	0.002	0.03	**0.03**		352.59		348.68	3.91
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	18.0	0.94	12.5	0.000	0.00	**0.00**		352.59		348.59	4.00
8	Bar Screen	10.9		**2.5**			7.2	2.33		0.000	1.20	**1.20**		351.39		348.59	2.80
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	9.4	1.78	9.3	0.003	0.05	**0.06**		351.33		348.18	3.15
10	Wet Well Inlet Area													**351.33**	**362.50**	**343.59**	**7.74**
11	Baffle Wall	21.8					24.0	1.41		0.00	0.08	**0.08**		351.25		340.25	11.00
12	Influent Pump Station Wet Well													**351.25**	**362.50**	**340.25**	**11.00**
13	Pump suction piping	12.0	**24**		**25.4**	0.5	3.14	5.91		0.11	0.27	**0.38**					
14	Influent Pump	12.0											**21.8**				
15	Pump discharge piping	12.0	**24**		**21.2**	3.3	3.14	5.91		0.09	1.76	**1.86**					
16	Piping to Primary Clarifier	12.0	**36**		**310**	5.0	7.07	2.63		0.19	0.54	**0.72**					
17	Primary Clarifier	12.0			**314**						0.07	**0.07**		**370.07**	**370.00**	**353.52**	**16.55**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width
24	ft^2	Baffle Wall Open Area

Operating Condition

2		**Bar Screen Channels**
2		**Pumps Online**
21.8	mgd	**Plant Flow Rate**
2.2	mgd	**Recycle Flow Rate**

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 02**
Description Influent Sewer Minor Losses

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Butterfly V 0.3
Exit to Parshall Flume								1					
Totals	0	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00
		0.30											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 06**
Description Bar Screen Channel - Upstream of bar screen

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Gate V 0.6
Inlet Gate													1
Expansion								1					
Channel Length	12.25												
Totals	12.25	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.60
		0.90											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 09**
Description Bar Screen Channel - downstream of bar screen

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Gate V 0.6
Contraction										1			
Outlet Gate			1										
Channel Length	11												
Totals	11	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
		1.10											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 13**
Description Pump suction piping

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Ball V 0.04	Butterfly V 0.3
Inlet Bell		1											
Inlet Pipe	25.42												
Totals	25.42	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.50											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 15**
Description Pump discharge piping

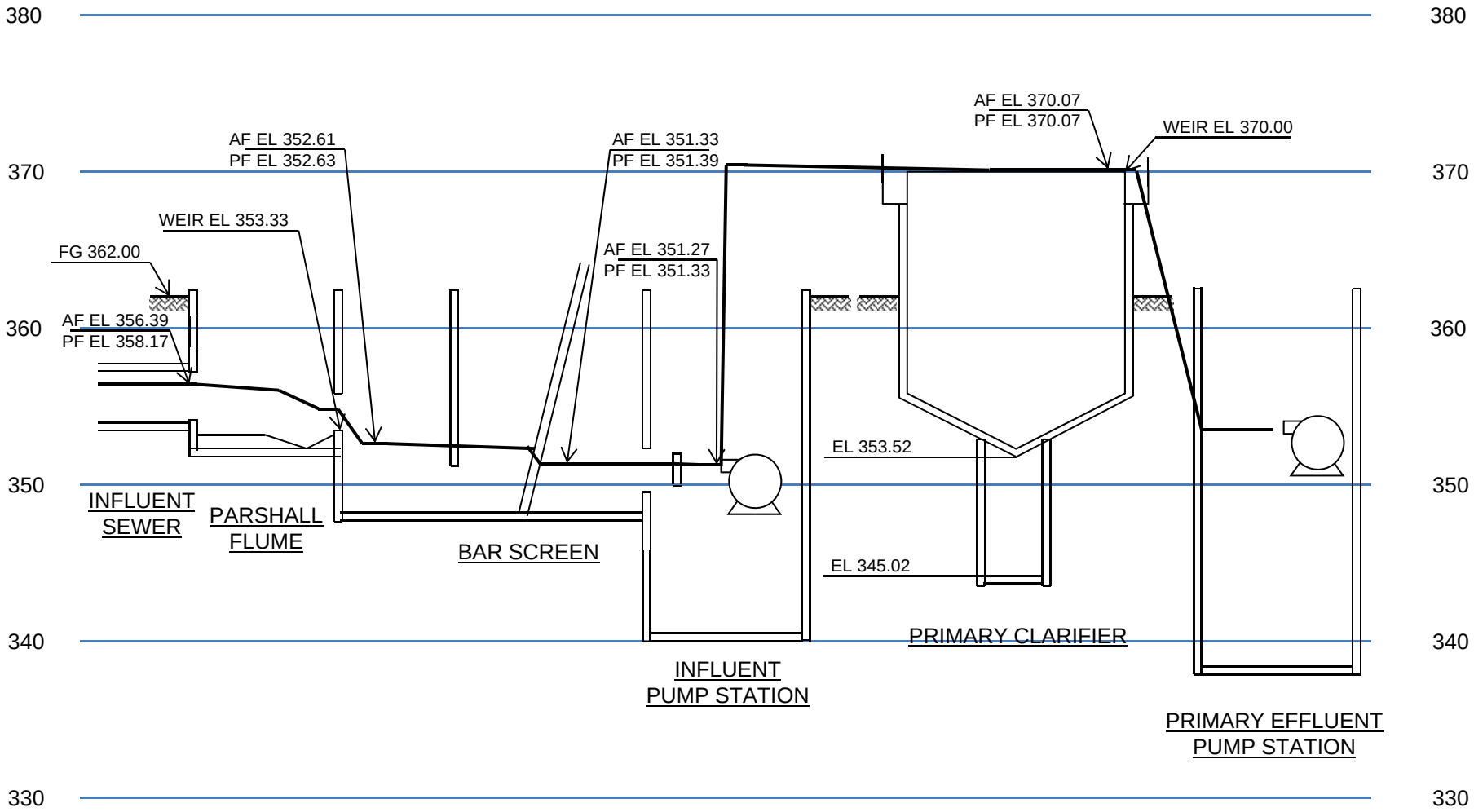
Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Check V 2.00	Plug V 0.5
Bends				1		1							
Valves												1	1
Discharge Pipe	21.2												
Totals	21.2	0.00	0.00	0.25	0.00	0.50	0.00	0.00	0.00	0.00	0.00	2.00	0.50
		3.25											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 15**
Description Piping to Clarifier

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Check V 2.00	Plug V 0.5
Bends				4	10								
Valves													3
Exit to Clarifier			1										
Total Length	310												
Totals	310	0.00	1.00	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50
		5.00											

Attachment 2
Option 1 Hydraulic Profile Drawing



OPTION 1 – HYDRAULIC PROFILE

AF EL: HGL AT AVG FLOW (10.9 MGD + 2.0 RECYCLE)
PF EL: HGL AT PEAK FLOW (21.8 MGD + 2.2 RECYCLE)*

HGL AT AVG FLOW ("AF EL") IS DRAWN ON FIGURE WITH BOLD LINE

*PEAK FLOW HGL ELEVATIONS ASSUME 2 BAR SCREEN CHANNELS, 2 CLARIFIERS, 2 INFLUENT PUMPS ONLINE, AND PIPING ACCORDING TO CAROLLO'S DESIGN

Attachment 3
Option 1 Clarifier Sizing

Palm Springs WWTP: Option 1 Primary Clarifier Sizing

Design Basis

$Q_{PI.Avg} := 12.9mgd$

$Q_{PI.Peak} := 24.0mgd$

Assumed average and peak flow rates, including recycle.
(Sheet 00G05)

Clarifier Configuration and Geometry

$N_{Clarifiers} := 2$

$D_{Clarifier} := 100ft$

$EL_{Weir} := 370.00ft$ $EL_{Bottom} := 357.70ft$

$HW_{Clarifier} := EL_{Weir} - EL_{Bottom} = 12.3 \cdot ft$

$A_{Clarifier} := \pi\left(\frac{D_{Clarifier}}{2}\right)^2 = 7.854 \times 10^3 \cdot ft^2$

$Vol_{Clarifier} := HW_{Clarifier} \cdot A_{Clarifier} = 0.723 \cdot mgal$

Clarifier dimensions, neglecting conical bottom portion.
(Sheets 20S-01 and 20S-02)

Overflow Rate and Detention Time

$V_{Up.Avg} := \frac{Q_{PI.Avg}}{N_{Clarifiers} \cdot A_{Clarifier}} = 0.387 \cdot \frac{mm}{s}$

$V_{Up.Avg} = 821 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Avg} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Avg}}$

$t_{Avg} = 2.7 \cdot hr$

$V_{Up.Peak} := \frac{Q_{PI.Peak}}{N_{Clarifiers} \cdot A_{Clarifier}} = 0.721 \cdot \frac{mm}{s}$

$V_{Up.Peak} = 1528 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Peak} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Peak}}$

$t_{Peak} = 1.4 \cdot hr$

These values are within the typical range for primary clarifiers. (Metcalf & Eddy, 2003)

Attachment 4
Option 2-3 Hydraulic Profile Calculations

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 2 - Without Influent Pump Station - Average Flow

Calc By: MJA
Chkd: _____

			FLOW PATH CHARACTERISTICS				HYDRAULIC CALCULATIONS							ELEVATIONS (ft AMSL)			
		Flow (MGD)	Diameter (in)	Width (ft)	Length (ft)	K Value	Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	**Total HL (ft)**	**Pump Head (ft)**	HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**356.39**	**357.44**	**353.94**	**2.45**
2	Sewer Pipe exit	10.9	**42**			0.3	7.12	2.37		0.00	0.03	**0.03**		356.37		353.94	2.43
3	Parshall Flume	10.9		**2**			2.34	7.22		0.00	1.62	**1.62**		354.75		353.58	1.17
4	Exit weir	10.9			**3**		4.25	3.97		0.00	1.42	**1.42**		354.75	353.33		1.42
5	Bar Screen Channel Inlet Area													**353.14**	**362.50**	**348.86**	**4.28**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	13.3	1.27	11.9	0.001	0.02	**0.02**		353.12		348.68	4.44
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	20.4	0.83	13.5	0.000	0.00	**0.00**		353.11		348.59	4.52
8	Bar Screen	10.9		**2.5**			10.1	1.67		0.000	0.62	**0.62**		352.50		348.59	3.91
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	12.9	1.31	11.6	0.001	0.03	**0.03**		352.47		348.18	4.29
10	Splitter Box													**352.47**	**362.50**	**343.59**	**8.88**
11	Piping to Primary Clarifier	12.9	**36**		**310**	5.5	7.07	2.82		0.22	0.68	**0.90**					
12	Primary Clarifier													**351.57**	**351.50**	**342.50**	**9.07**
13	Primary Clarifier Weir	12.9			**314**					0.00	0.07	**0.07**		351.57	351.50		0.07
14	Primary Effluent Box	12.9								0.00	0.00	**0.00**		350.72		346.68	4.04
15	Piping to Primary Effluent Pump Station - 42"	12.9	**42**		**650**	2.2	9.62	2.07		0.21	0.15	**0.36**					
16	Piping to Primary Effluent Pump Station - 36"	12.9	**36**		**30**	2.3	7.07	2.82		0.02	0.28	**0.30**					
17	Piping to Primary Effluent Pump Station - 48"	12.9	**48**		**70**	1.3	12.57	1.59		0.01	0.05	**0.06**					
18	Existing Primary Effluent Pump Station													**350.00**	**362.50**	**348.00**	**2.00**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width

Operating Condition

1		**Bar Screen Channels**
1		**Clarifiers Online**
10.9	mgd	**Plant Flow Rate**
2.0	mgd	**Recycle Flow Rate**

Modified Elevations

351.50	ft AMSL	Lowered Primary Clarifier Weir
350.00	ft AMSL	Lowered Target WSE in PEPS

Weir Check

FREE FLOW	Parshall Flume exit weir
FREE FLOW	Primary Clarifier Weir

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 3 - Single Clarifier - Average Flow

Calc By: MJA
Chkd:

		Flow (MGD)	FLOW PATH CHARACTERISTICS Diameter (in)	Width (ft)	Length (ft)	K Value	HYDRAULIC CALCULATIONS Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	Total HL (ft)	Pump Head (ft)	ELEVATIONS (ft AMSL) HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**356.39**	**357.44**	**353.94**	**2.45**
2	Sewer Pipe exit	10.9	**42**			0.3	7.12	2.37		0.00	0.03	**0.03**		356.37		353.94	2.43
3	Parshall Flume	10.9		**2**			2.34	7.22		0.00	1.62	**1.62**		354.75		353.58	1.17
4	Exit weir	10.9			**3**		4.25	3.97		0.00	1.42	**1.42**		354.75	353.33		1.42
5	Bar Screen Channel Inlet Area													**352.78**	**362.50**	**348.86**	**3.92**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	12.2	1.38	11.1	0.002	0.03	**0.03**		352.75		348.68	4.07
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	18.7	0.90	12.8	0.000	0.00	**0.00**		352.75		348.59	4.16
8	Bar Screen	10.9		**2.5**			8.5	1.98		0.000	0.87	**0.87**		351.88		348.59	3.29
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	11.0	1.54	10.3	0.002	0.04	**0.04**		351.84		348.18	3.66
10	Splitter Box													**351.84**	**362.50**	**343.59**	**8.25**
11	Piping to Primary Clarifier	12.9	**48**		**310**	5.5	12.57	1.59		0.05	0.22	**0.27**					
12	Primary Clarifier													**351.57**	**351.50**	**342.50**	**9.07**
13	Primary Clarifier Weir	12.9			**314**					0.00	0.07	**0.07**		351.57	351.50		0.07
14	Primary Effluent Box	12.9								0.00	0.00	**0.00**		350.29		346.68	3.61
15	Piping to Primary Effluent Pump Station - 42"	12.9	**48**		**750**	4.2	12.57	1.59		0.13	0.16	**0.29**					
16	Existing Primary Effluent Pump Station													**350.00**	**362.50**	**348.00**	**2.00**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width

Operating Condition

1		**Bar Screen Channels**
1		**Clarifiers Online**
10.9	mgd	**Plant Flow Rate**
2.0	mgd	**Recycle Flow Rate**

Modified Elevations

351.50	ft AMSL	Lowered Primary Clarifier Weir
350.00	ft AMSL	Lowered Target WSE in PEPS

Weir Check

FREE FLOW	Parshall Flume exit weir
FREE FLOW	Primary Clarifier Weir

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 2 - Without Influent Pump Station - Peak Flow

Calc By: MJA
Chkd:

		Flow (MGD)	FLOW PATH CHARACTERISTICS Diameter (in)	Width (ft)	Length (ft)	K Value	HYDRAULIC CALCULATIONS Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	Total HL (ft)	Pump Head (ft)	ELEVATIONS (ft AMSL) HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**358.17**	**357.44**	**353.94**	**4.23**
2	Sewer Pipe exit	21.8	**42**			0.3	9.62	3.51		0.00	0.06	**0.06**		358.11		353.94	4.17
3	Parshall Flume	21.8		**2**			4.00	8.43		0.00	2.53	**2.53**		355.58		353.58	2.00
4	Exit weir	21.8			**3**		6.75	5.00		0.00	2.25	**2.25**		355.58	353.33		2.25
5	Bar Screen Channel Inlet Area													**353.06**	**362.50**	**348.86**	**4.20**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	13.1	1.29	11.7	0.001	0.02	**0.02**		353.03		348.68	4.35
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	20.0	0.84	13.4	0.000	0.00	**0.00**		353.03		348.59	4.44
8	Bar Screen	10.9		**2.5**			9.8	1.72		0.000	0.66	**0.66**		352.38		348.59	3.79
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	12.5	1.35	11.3	0.001	0.03	**0.03**		352.35		348.18	4.17
10	Splitter Box													**352.35**	**362.50**	**343.59**	**8.76**
11	Piping to Primary Clarifier	12.0	**36**		**310**	5.5	7.07	2.63		0.19	0.59	**0.78**					
12	Primary Clarifier													**351.57**	**351.50**	**342.50**	**9.07**
13	Primary Clarifier Weir	12.0			**314**					0.00	0.07	**0.07**		351.57	351.50		0.07
14	Primary Effluent Box	12.0								0.00	0.00	**0.00**		350.63		346.68	3.95
15	Piping to Primary Effluent Pump Station - 42"	12.0	**42**		**650**	2.2	9.62	1.93		0.19	0.13	**0.31**					
16	Piping to Primary Effluent Pump Station - 36"	12.0	**36**		**30**	2.3	7.07	2.63		0.02	0.24	**0.26**					
17	Piping to Primary Effluent Pump Station - 48"	12.0	**48**		**70**	1.3	12.57	1.48		0.01	0.04	**0.05**					
18	Existing Primary Effluent Pump Station													**350.00**	**362.50**	**348.00**	**2.00**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width

Operating Condition

2		**Bar Screen Channels**
2		**Clarifiers Online**
21.8	mgd	**Plant Flow Rate**
2.2	mgd	**Recycle Flow Rate**

Modified Elevations

351.50	ft AMSL	Lowered Primary Clarifier Weir
350.00	ft AMSL	Lowered Target WSE in PEPS

Weir Check

FREE FLOW	Parshall Flume exit weir
FREE FLOW	Primary Clarifier Weir

CITY OF PALM SPRINGS
HEADWORKS AND PRIMARY CLARIFIER UPGRADE

Option 3 - Single Clarifier - Peak Flow

Calc By: MJA
Chkd:

			FLOW PATH CHARACTERISTICS				HYDRAULIC CALCULATIONS							ELEVATIONS (ft AMSL)			
		Flow (MGD)	Diameter (in)	Width (ft)	Length (ft)	K Value	Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Friction Loss (ft)	Minor Loss (ft)	**Total HL (ft)**	**Pump Head (ft)**	HGL	Top of Structure	Bottom of Structure	Water Depth (ft)
1	Influent Sewer													**358.17**	**357.44**	**353.94**	**4.23**
2	Sewer Pipe exit	21.8	**42**			0.3	9.62	3.51		0.00	0.06	**0.06**		358.11		353.94	4.17
3	Parshall Flume	21.8		**2**			4.00	8.43		0.00	2.53	**2.53**		355.58		353.58	2.00
4	Exit weir	21.8			**3**		6.75	5.00		0.00	2.25	**2.25**		355.58	353.33		2.25
5	Bar Screen Channel Inlet Area													**353.17**	**362.50**	**348.86**	**4.31**
6	Channel upstream of Bar Screen	10.9		**3.0**	**12.25**	0.9	13.4	1.26	11.9	0.001	0.02	**0.02**		353.15		348.68	4.47
7	Bar Screen channel section	10.9		**4.5**	**6.92**	0.0	20.5	0.82	13.6	0.000	0.00	**0.00**		353.15		348.59	4.56
8	Bar Screen	10.9		**2.5**			10.3	1.65		0.000	0.60	**0.60**		352.55		348.59	3.96
9	Channel downstream of Bar Screen	10.9		**3.0**	**11.00**	1.1	13.0	1.29	11.7	0.001	0.03	**0.03**		352.52		348.18	4.34
10	Splitter Box													**352.52**	**362.50**	**343.59**	**8.93**
11	Piping to Primary Clarifier	24.0	**48**		**310**	5.5	12.57	2.95		0.17	0.75	**0.91**					
12	Primary Clarifier													**351.61**	**351.50**	**342.50**	**9.11**
13	Primary Clarifier Weir	24.0			**314**					0.00	0.11	**0.11**		351.61	351.50		0.11
14	Primary Effluent Box	24.0								0.00	0.00	**0.00**		350.97		346.68	4.29
15	Piping to Primary Effluent Pump Station - 48"	24.0	**48**		**750**	4.2	12.57	2.95		0.41	0.57	**0.97**					
16	Existing Primary Effluent Pump Station													**350.00**	**362.50**	**348.00**	**2.00**

Constants

130	Hazen-Williams "C"
0.013	Manning "n"
3.33	Weir Coefficient "C_w"
8	Parshall Flume "C"
1.55	Parshall Flume "n"
0.07	Bar Screen Coefficient
0.62	Vena Contracta Coefficient

System Geometry

100	ft	Clarifier Diameter
15	deg	Bar Screen Angle
2.5	ft	Bar Screen Clear Width

Operating Condition

2		**Bar Screen Channels**
1		**Clarifiers Online**
21.8	mgd	**Plant Flow Rate**
2.2	mgd	**Recycle Flow Rate**

Modified Elevations

351.50	ft AMSL	Lowered Primary Clarifier Weir
350.00	ft AMSL	Lowered Target WSE in PEPS

Weir Check

FREE FLOW	Parshall Flume exit weir
FREE FLOW	Primary Clarifier Weir

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 02**
Description Influent Sewer Minor Losses

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Butterfly V 0.3
Exit to Parshall Flume								1					
Totals	0	0.00 **0.30**	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 06**
Description Bar Screen Channel - Upstream of bar screen

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Gate V 0.6
Inlet Gate													1
Expansion								1					
Channel Length	12.25												
Totals	12.25	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.60
		0.90											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 09**
Description Bar Screen Channel - downstream of bar screen

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Expansion (Open Channel) 0.30		Contraction (Open Channel) 0.10		Ball V 0.04	Gate V 0.6
Contraction										1			
Outlet Gate			1										
Channel Length	11												
Totals	11	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
		1.10											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 11**
Description Piping to Clarifier

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Check V 2.00	Plug V 0.5
Pipe Entrance		1											
Bends				4	10								
Valves													3
Exit to Clarifier			1										
Total Length	310												
Totals	310	0.50	1.00	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50
		5.50											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 15**

Description Piping to Primary Effluent Pump Station - 42"

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Gate V 0.60	Plug V 0.5
Pipe Entrance		1											
Bends				2	3		1						
Valves												1	
Total Length	650												
Totals	650	0.50	0.00	0.50	0.45	0.00	0.15	0.00	0.00	0.00	0.00	0.60	0.00
		2.20											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 16**

Description Piping to Primary Effluent Pump Station - 36"

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Gate V 0.60	Plug V 0.5
Contraction										3.5	3		
Fittings						2							
Expansion								3	4				
Total Length	30												
Totals	30	0.00	0.00	0.00	0.00	1.00	0.00	-2.70	3.60	2.45	-2.10	0.00	0.00
		2.25											

PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 17**

Description Piping to Primary Effluent Pump Station - 48"

Elements	L	Ent 0.50	Exit 1.00	90El 0.25	45El 0.15	BFT 0.50	LFT 0.15	Increaser from -0.90	Increaser to 0.90	Reducer from 0.70	Reducer to -0.70	Gate V 0.60	Plug V 0.5
Bends				1									
Exit to Wet Well			1										
Total Length	70												
Totals	70	0.00	1.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1.25											

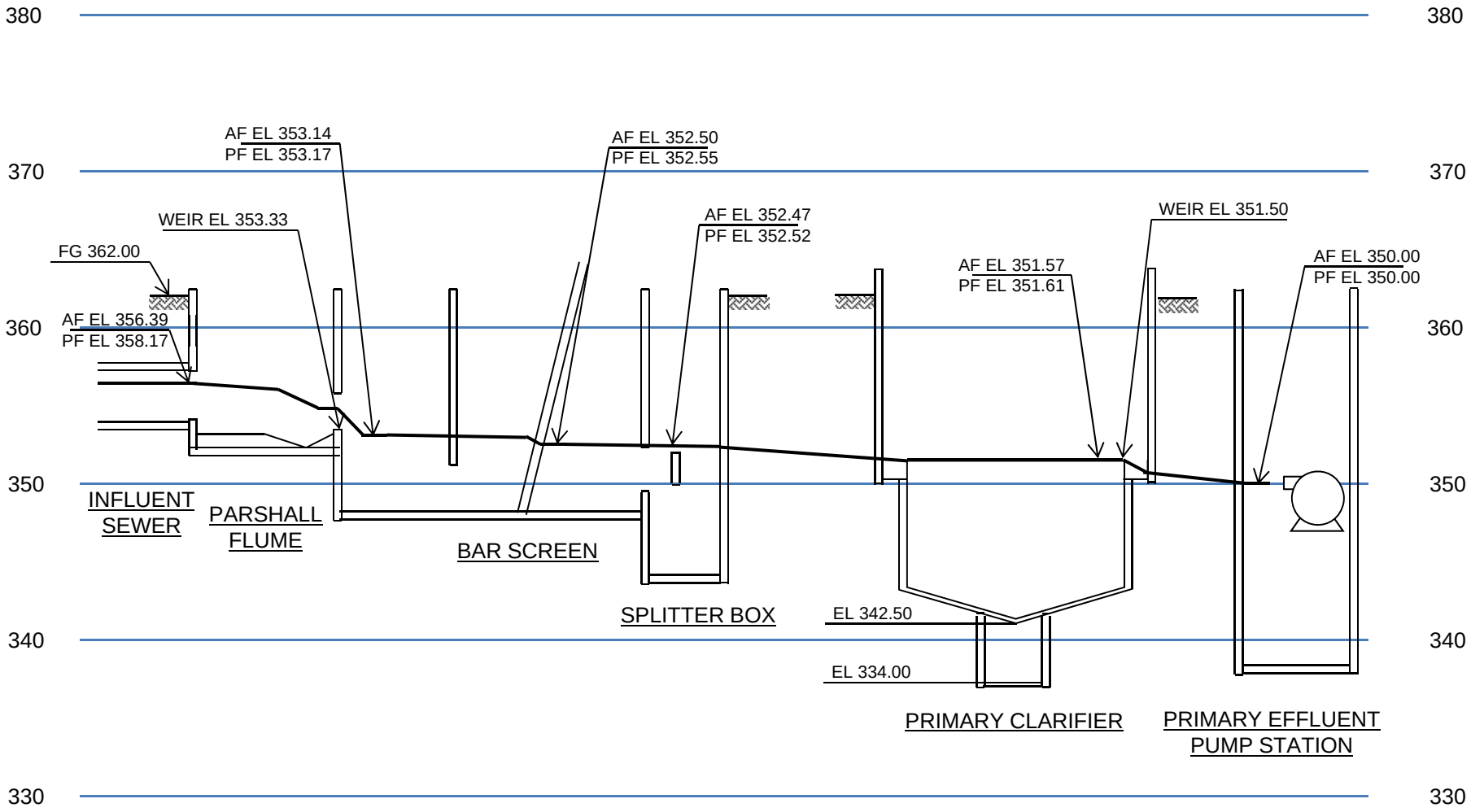
PIPE HYDRAULIC ITEMIZATIONS

Pipe Number **00 00 15**

Description Piping to Primary Effluent Pump Station - Option 3

								Increaser		Reducer			
		Ent	Exit	90El	45El	BFT	LFT	from	to	from	to	Gate V	Plug V
Elements	L	0.50	1.00	0.25	0.15	0.50	0.15	-0.90	0.90	0.70	-0.70	0.60	0.5
Pipe Entrance		1											
Bends				2	3	2	1						
Valves												1	
Exit			1										
Total Length	750												
Totals	750	0.50	1.00	0.50	0.45	1.00	0.15	0.00	0.00	0.00	0.00	0.60	0.00
		4.20											

Attachment 5
Option 2-3 Hydraulic Profile Drawing



OPTION 2 & 3 – HYDRAULIC PROFILE

AF EL: HGL AT AVG FLOW (10.9 MGD + 2.0 RECYCLE)
PF EL: HGL AT PEAK FLOW (21.8 MGD + 2.2 RECYCLE)*

HGL AT AVG FLOW ("AF EL") IS DRAWN ON FIGURE WITH BOLD LINE

*PEAK FLOW HGL ELEVATIONS ASSUME 2 BAR SCREEN CHANNELS, 1 CLARIFIER, AND 48" PIPING FROM SPLITTER BOX TO PRIMARY CLARIFIER AND FROM PRIMARY CLARIFIER EFFLUENT TO PRIMARY EFFLUENT PUMP STATION (CORRESPONDS WITH OPTION 3 IN THE TEXT)

Attachment 6
Option 2 Clarifier Sizing

Palm Springs WWTP: Option 2 Primary Clarifier Sizing

Design Basis

$Q_{PI.Avg} := 12.9mgd$

$Q_{PI.Peak} := 24.0mgd$

Assumed average and peak flow rates, including recycle. (Sheet 00G05)

Clarifier Configuration and Geometry

$N_{Clarifiers} := 2$

$D_{Clarifier} := 100ft$

$EL_{Weir} := 351.5ft$ $EL_{Bottom} := 342.5ft$

Proposed dimensions of below-grade clarifier.

$HW_{Clarifier} := EL_{Weir} - EL_{Bottom} = 9 \cdot ft$

$A_{Clarifier} := \pi\left(\frac{D_{Clarifier}}{2}\right)^2 = 7.854 \times 10^3 \cdot ft^2$

$Vol_{Clarifier} := HW_{Clarifier} \cdot A_{Clarifier} = 0.529 \cdot mgal$

Overflow Rate and Detention Time

$V_{Up.Avg} := \frac{Q_{PI.Avg}}{N_{Clarifiers} \cdot A_{Clarifier}} = 0.387 \cdot \frac{mm}{s}$

$V_{Up.Avg} = 821 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Avg} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Avg}}$

$t_{Avg} = 2 \cdot hr$

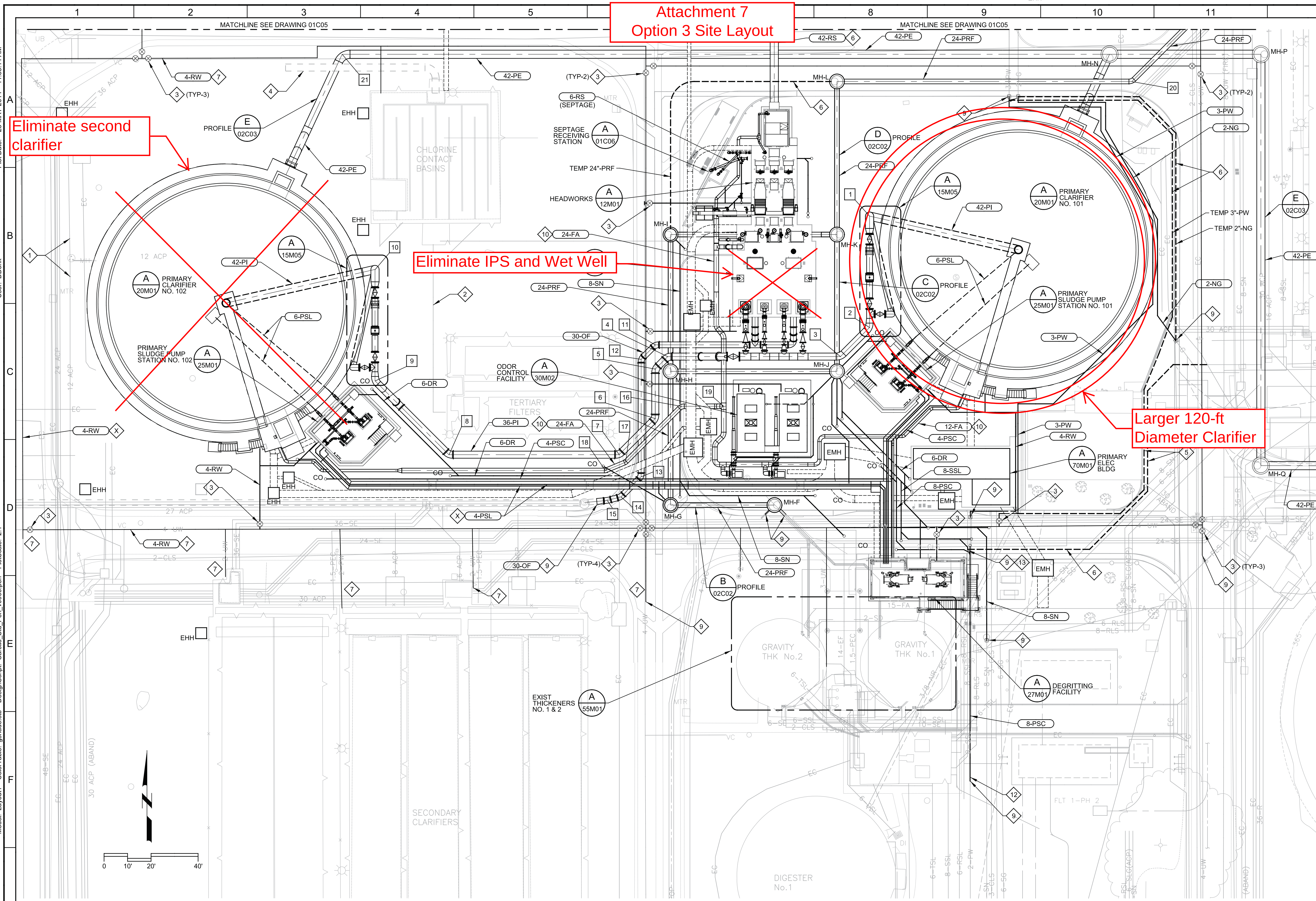
$V_{Up.Peak} := \frac{Q_{PI.Peak}}{N_{Clarifiers} \cdot A_{Clarifier}} = 0.721 \cdot \frac{mm}{s}$

$V_{Up.Peak} = 1528 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Peak} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Peak}}$

$t_{Peak} = 1.1 \cdot hr$

These values are within the typical range for primary clarifiers. (Metcalf & Eddy, 2003)



GENERAL NOTES

1. THE FOLLOWING GENERAL NOTES AND KEY NOTES APPLY TO DWGS 01C04 AND 01C05.
2. REFER TO CONSTRUCTION SEQUENCE AND CONSTRAINTS FOR WORK IN THIS AREA PER SPECIFICATION SECTION 01140.
3. SEE DWG 01C01 FOR GENERAL YARD NOTES AND GENERAL YARD DRAWINGS LEGEND.
4. CONCRETE ENCASE ALL PIPING UNDER CONCRETE SLAB, RAMP, SIDEWALK, AND TRUCK LOADING PAD PER P040/TYP, WHETHER SHOWN OR NOT.
5. UNLESS OTHERWISE NOTED, PROVIDE TYP DET P342 FOR DIP CONNECTIONS AT WALL PENETRATIONS.
6. ELECTRICAL DUCTBANKS. — — — —
7. FOR MANHOLE PIPE ORIENTATION DETAILS SEE DWG 01C12.
8. CONTRACTOR SHALL FIELD VERIFY PIPE MATERIALS, SIZES, AND ELEVATIONS PRIOR TO PREPARATION OF SHOP DRAWINGS.
9. COORDINATE PIPE INSTALLATION WITH PIPE DEMOLITION AS SHOWN ON 01D01
10. REFER TO DRAWING 01C15 FOR COORDINATE CONTROL DATA.

KEY NOTES

1. PROTECT 12" ACP PIPE NORTH AND SOUTH OF EXISTING MANHOLE.
2. PROTECT 27" ACP PIPE BETWEEN CHLORINE CONTACT BASINS AND TERTIARY FILTERS.
3. BURIED BFV IN VALVE BOX PER P026/TYP
4. PROTECT 36" ACP PIPE NORTH OF CHLORINE CONTACT BASINS.
5. NEAR EXISTING CHLORINE BUILDING, ATTACH TEMPORARY PIPE TO DOCK AND PROTECT WITH GUARD POSTS SIM TO TYP C160.
6. INSTALL TEMPORARY PIPE AROUND CONSTRUCTION SITE SIMILAR TO LAYOUT SHOWN ON DRAWINGS. PROTECT TEMPORARY PIPE IN PLACE AFTER INSTALLATION.
7. EXISTING 4" PVC LINE IS PRONE TO BREAKAGE. AS SPECIFIED IN SPECIFICATION SECTION 01140, CONSTRUCT NEW 4" RW ADJACENT TO EXISTING 4" PVC TO REPLACE 4" PVC SERVICE LOOP AND ALL SERVICE CONNECTIONS, INCLUDING BUT NOT LIMITED TO THOSE THAT ARE SHOWN ON THE DRAWINGS. USE A FLEXIBLE COUPLING AT EACH SERVICE LOCATION. OUTSIDE OF EXISTING STRUCTURES, CONNECT TO NEAREST COLLAR, REPAIR OR REPLACE ANY VISIBLE LEAKAGE TO EXISTING PIPE LEFT IN SERVICE. FIVE ADDITIONAL CONNECTIONS TO BE FIELD LOCATED AT NO ADDITIONAL COST.
8. SEE PROFILE A ON DRAWING 02C01.
9. REFER TO DRAWING 01C14 FOR NEW PIPE TO EXISTING PIPE CONNECTION DETAILS.
10. SEE PROFILE F ON DRAWING 02C04.
11. CONNECT WITH RESTRAINED FLEXIBLE COUPLING THEN INSTALL FILED CLOSURE PER TYP P008A.
12. CONNECT UPSTREAM (NORTH) OF EXISTING PLUG VALVE. INSTALL TEE AND BURIED PLUG VALVE SIMILAR TO TYP P026 TO CONNECT NEW INTO EXISTING WHILE MAINTAINING ABILITY TO CONTINUE USE OF EXISTING RSL SERVICE.
13. CONNECT DOWNSTREAM (NORTH) OF EXISTING TEE.

REV	DATE	BY	DESCRIPTION

DESIGNED KM/HT
DRAWN DJD/AE
CHECKED LJE
DATE MAY 2014

REGISTERED PROFESSIONAL ENGINEER KATHLEEN J. ... No. 42651 CIVIL STATE OF CALIFORNIA 5/27/14

CITY OF PALM SPRINGS
Dave Barakian 5/27/14
DAVE BARAKIAN, CITY ENGINEER R.C.E. No. 28931 DATE
VEOLIA WATER WEST OPERATING SERVICES, INC.
Fadi Alabbas 5/27/14
FADI ALABBAS, REGIONAL DIRECTOR, CPM DATE

carollo® VEOLIA WATER

CITY OF PALM SPRINGS - VEOLIA WATER WOS, INC.
HEADWORKS AND PRIMARY CLARIFIER UPGRADE
CIVIL
Option 3 Site Layout

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

VEOLIA PROJECT 1006740
JOB NO. 9328A.10
DRAWING NO. 01C04
SHEET NO. 11 OF 168

PROJECT NO. 9328A10 FILE NAME: 9328A10_01C04.dgn

Plot Date: 23-MAY-2014 11:58:14 AM User: DDonk PlotScale: 2:1 DesignScript: Carollo_Std_Pen_v0905.pen ColorTable: gshade.ctb Model: Layout1 LAST SAVED BY: ddonk

Attachment 8
Option 3 Clarifier Sizing

Palm Springs WWTP: Option 3 Primary Clarifier Sizing

Design Basis

$Q_{PI.Avg} := 12.9mgd$

$Q_{PI.Peak} := 24.0mgd$

Assumed average and peak flow rates, including recycle. (Sheet 00G05)

Clarifier Configuration and Geometry

$N_{Clarifiers} := 1$

$D_{Clarifier} := 120ft$

$EL_{Weir} := 351.5ft$ $EL_{Bottom} := 342.5ft$

Proposed dimensions of below-grade single clarifier.

$HW_{Clarifier} := EL_{Weir} - EL_{Bottom} = 9 \cdot ft$

$A_{Clarifier} := \pi \left(\frac{D_{Clarifier}}{2} \right)^2 = 1.131 \times 10^4 \cdot ft^2$

$Vol_{Clarifier} := HW_{Clarifier} \cdot A_{Clarifier} = 0.761 \cdot mgal$

Overflow Rate and Detention Time

$V_{Up.Avg} := \frac{Q_{PI.Avg}}{N_{Clarifiers} \cdot A_{Clarifier}} = 0.538 \cdot \frac{mm}{s}$

$V_{Up.Avg} = 1141 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Avg} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Avg}}$

$t_{Avg} = 1.4 \cdot hr$

$V_{Up.Peak} := \frac{Q_{PI.Peak}}{N_{Clarifiers} \cdot A_{Clarifier}} = 1.001 \cdot \frac{mm}{s}$

$V_{Up.Peak} = 2122 \cdot \frac{gal}{ft^2 \cdot day}$

$t_{Peak} := \frac{N_{Clarifiers} \cdot Vol_{Clarifier}}{Q_{PI.Peak}}$

$t_{Peak} = 0.8 \cdot hr$

Average overflow rate is on the high end of the design range, and average detention time is on the low end. (Metcalf & Eddy, 2003)

Attachment 9
OPCC Calculations

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 1 - WITH INFLUENT PUMP STATION (IPS) **$17,082,469**

		Unit	QTY	Cost	Subtotal
1	**General Contractor's Expenses**				**$222,000**
	Mobilization and Demobilization	LS	1	$150,000	$150,000
	Trailers, Phones, Maintenance	Mo	24	$3,000	$72,000
2	**Influent Sewer JB**				**$52,825**
	Excavation & Backfill	CY	41	$125	$5,125
	Concrete Structure	CY	45	$1,000	$45,000
	Top Alum Cover	SQF	90	$30	$2,700
3	**Parshall Flume & Bar Screen Structure**				**$1,160,920**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	474	$1,000	$474,000
	Top Alum Cover	SQF	564	$30	$16,920
	Parshall Flume	LS	1	$5,000	$5,000
	Barscreen	EA	2	$200,000	$400,000
	Screening Conveyor	EA	1	$100,000	$100,000
	Gates & Motorized operator	EA	5	$15,000	$75,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
	Piping	LS	1	$50,000	$50,000
4	**Influent Pump Station**				**$1,790,260**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	1,286	$1,000	$1,286,000
	Top Alum Cover	SQF	142	$30	$4,260
	Gates & Motorized operator	EA	2	$15,000	$30,000
	Instrumentation and electrical	LS	1	$70,000	$70,000
	Piping & Valves	LS	1	$80,000	$80,000
	Influent Turbine Pumps	EA	4	$80,000	$320,000
5	**Two Clarifiers - 100-FT diameter - Grade level**				**$7,431,600**
	Excavation & Backfill (within shorings)	CY	7,480	$25	$187,000
	Concrete Structure	CY	11,191	$600	$6,714,600
	Clarifier Mechanical	LS	2	$175,000	$350,000

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 1 - WITH INFLUENT PUMP STATION (IPS) **$17,082,469**

		Unit	QTY	Cost	Subtotal
	Instrumentation and electrical	LS	2	$40,000	$80,000
	Piping & Valves	LS	2	$50,000	$100,000
	Shoring: Excavation vertical cut protection	SQF	8,900	$28	$249,200
6	**Two Primary Sludge PS**				**$148,400**
	Concrete Pad	SQF	424	$100	$42,400
	Piping & Valves	LS	2	$12,000	$24,000
	Pumps	LS	4	$8,000	$32,000
	Instrumentation and electrical	LS	2	$25,000	$50,000
7	**Odor Control Facility**				**$268,000**
	Concrete Pad	SQF	280	$100	$28,000
	Equipment	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$50,000	$50,000
	Instrumentation and electrical	LS	1	$30,000	$30,000
8	**Degriting Facility**				**$375,000**
	Concrete Pad	SQF	700	$100	$70,000
	Galv Steel Structure	LS	1	$25,000	$25,000
	Cyclone	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$80,000	$80,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
9	**Primary Electrical Building**				**$479,360**
	Concrete Pad	SQF	1,042	$80	$83,360
	Building	SQF	700	$80	$56,000
	MCC, includes 4 VFD for IPS	LS	1	$170,000	$170,000
	Control Panels	LS	1	$50,000	$50,000
	Transformer, Service SCE	LS	1	$40,000	$40,000
	Modifications to SWGR-MSG	LS	1	$80,000	$80,000
10	**Existing Digester 2 (R=43') Dome Replacement**				**$982,000**
	Dome removal	SQF	5,808	$40	$232,320

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 1 - WITH INFLUENT PUMP STATION (IPS) **$17,082,469**

		Unit	QTY	Cost	Subtotal
	Dome Replacement	SQF	5,808	$100	$580,800
	Repair & Recoat Walls	SQF	5,944	$20	$118,880
	Piping	LS	1	$50,000	$50,000
11	**PI pipe between IPS and Clarifiers**				**$63,802**
	36" STL	FT	146	$437	$63,802
12	**RS Pipe**				**$112,500**
	42" RCP	FT	225	$500	$112,500
13	**PSL Pipe**				**$108,600**
	DI	FT	362	$300	$108,600
14	**SSL Pipe**				**$24,250**
	8" DI	FT	65	$200	$13,000
	8" PVC Temp	FT	75	$150	$11,250
15	**PE Pipe**				**$199,000**
	42" STL	FT	368	$500	$184,000
	MH	EA	3	$5,000	$15,000
16	**PRF Pipe**				**$167,000**
	24" DI	FT	330	$400	$132,000
	MH	EA	7	$5,000	$35,000
17	**Other Small Piping**				**$500,000**
	Drain	LS	1	$300,000	$300,000
	PW	LS	1	$200,000	$200,000
18	**Other Small Equipment**				**$400,000**
	Small Equipment	LS	1	$400,000	$400,000
19	**Other Miscellaneous concrete**				**$300,000**
	Miscellaneous Concrete	LS	1	$300,000	$300,000

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 1 - WITH INFLUENT PUMP STATION (IPS) **$17,082,469**

		Unit	QTY	Cost	Subtotal
20	**Roads**				**$744,000**
	Curb & Gutters, Galv Steel Grating	LS	1	$120,000	$120,000
	Grading & 12" Base & Asphalt Paving	SQY	4,160	$150	$624,000
	Total				**$15,529,517**
	Contingency 10% for Order of Magnitude approach				$1,552,951.70
	TOTAL				**$17,082,469**

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 2 - WITHOUT INFLUENT PUMP STATION $14,296,631

		Unit	QTY	Cost	Subtotal
1	**General Contractor's Expenses**				**$222,000**
	Mobilization and Demobilization	LS	1	$150,000	$150,000
	Trailers, Phones, Maintenance	Mo	24	$3,000	$72,000
2	**Influent Sewer JB**				**$52,825**
	Excavation & Backfill	CY	41	$125	$5,125
	Concrete Structure	CY	45	$1,000	$45,000
	Top Alum Cover	SQF	90	$30	$2,700
3	**Parshall Flume & Bar Screen Structure**				**$1,209,600**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	521	$1,000	$521,000
	Top Alum Cover	SQF	620	$30	$18,600
	Parshall Flume	LS	1	$5,000	$5,000
	Barscreen	EA	2	$200,000	$400,000
	Screening Conveyor	EA	1	$100,000	$100,000
	Gates & Motorized operator	EA	5	$15,000	$75,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
	Piping	LS	1	$50,000	$50,000
4	**Influent Pump Station**				**$0**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	0	$1,000	$0
	Top Alum Cover	SQF	0	$30	$0
	Gates & Motorized operator	EA	0	$15,000	$0
	Instrumentation and electrical	LS	0	$70,000	$0
	Piping & Valves	LS	0	$80,000	$0
	Influent Turbine Pumps	EA	0	$80,000	$0
5	**Two Clarifiers - 100-FT diameter - Deeper**				**$6,828,000**
	Excavation & Backfill (within shorings)	CY	14,000	$25	$350,000
	Concrete Structure	CY	10,230	$600	$6,138,000
	Clarifier Mechanical	LS	1	$250,000	$250,000

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 2 - WITHOUT INFLUENT PUMP STATION $14,296,631

		Unit	QTY	Cost	Subtotal
	Instrumentation and electrical	LS	1	$40,000	$40,000
	Piping & Valves	LS	1	$50,000	$50,000
	Shoring: Excavation vertical cut protection	SQF	12,055	$28	$337,540
6	**Two Primary Sludge PS**				**$74,200**
	Concrete Pad	SQF	212	$100	$21,200
	Piping & Valves	LS	1	$12,000	$12,000
	Pumps	LS	2	$8,000	$16,000
	Instrumentation and electrical	LS	1	$25,000	$25,000
7	**Odor Control Facility**				**$268,000**
	Concrete Pad	SQF	280	$100	$28,000
	Equipment	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$50,000	$50,000
	Instrumentation and electrical	LS	1	$30,000	$30,000
8	**Degriting Facility**				**$375,000**
	Concrete Pad	SQF	700	$100	$70,000
	Galv Steel Structure	LS	1	$25,000	$25,000
	Cyclone	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$80,000	$80,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
9	**Primary Electrical Building**				**$399,360**
	Concrete Pad	SQF	1,042	$80	$83,360
	Building	SQF	700	$80	$56,000
	MCC	LS	1	$90,000	$90,000
	Control Panels	LS	1	$50,000	$50,000
	Transformer, Service SCE	LS	1	$40,000	$40,000
	Modifications to SWGR-MSG	LS	1	$80,000	$80,000
10	**Existing Digester 2 (R=43') Dome Replacement**				**$982,000**
	Dome removal	SQF	5,808	$40	$232,320
	Dome Replacement	SQF	5,808	$100	$580,800

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 2 - WITHOUT INFLUENT PUMP STATION $14,296,631

		Unit	QTY	Cost	Subtotal
	Repair & Recoat Walls	SQF	5,944	$20	$118,880
	Piping	LS	1	$50,000	$50,000
11	**PI pipe between IPS and Clarifiers**				**$63,802**
	36" STL	FT	146	$437	$63,802
12	**RS Pipe**				**$112,500**
	42" RCP	FT	225	$500	$112,500
13	**PSL Pipe**				**$60,000**
	DI	FT	200	$300	$60,000
14	**SSL Pipe**				**$21,250**
	8" DI	FT	50	$200	$10,000
	8" PVC Temp	FT	75	$150	$11,250
15	**PE Pipe**				**$217,400**
	48" STL	FT	368	$550	$202,400
	MH	EA	3	$5,000	$15,000
16	**PRF Pipe**				**$167,000**
	24" DI	FT	330	$400	$132,000
	MH	EA	7	$5,000	$35,000
17	**Other Small Piping**				**$500,000**
	Drain	LS	1	$300,000	$300,000
	PW	LS	1	$200,000	$200,000
18	**Other Small Equipment**				**$400,000**
	Small Equipment	LS	1	$400,000	$400,000
19	**Other Miscellaneous concrete**				**$300,000**
	Miscellaneous Concrete	LS	1	$300,000	$300,000

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 2 - WITHOUT INFLUENT PUMP STATION $14,296,631

		Unit	QTY	Cost	Subtotal
20	**Roads**				**$744,000**
	Curb & Gutters, Galv Steel Grating	LS	1	$120,000	$120,000
	Grading & 12" Base & Asphalt Paving	SQY	4,160	$150	$624,000
	Total				**$12,996,937**
	Contingency 10% for Order of Magnitude approach				$1,299,693.70
	TOTAL				**$14,296,631**

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 3 - SINGLE CLARIFIER $12,256,131

		Unit	QTY	Cost	Subtotal
1	**General Contractor's Expenses**				**$222,000**
	Mobilization and Demobilization	LS	1	$150,000	$150,000
	Trailers, Phones, Maintenance	Mo	24	$3,000	$72,000
2	**Influent Sewer JB**				**$52,825**
	Excavation & Backfill	CY	41	$125	$5,125
	Concrete Structure	CY	45	$1,000	$45,000
	Top Alum Cover	SQF	90	$30	$2,700
3	**Parshall Flume & Bar Screen Structure**				**$1,209,600**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	521	$1,000	$521,000
	Top Alum Cover	SQF	620	$30	$18,600
	Parshall Flume	LS	1	$5,000	$5,000
	Barscreen	EA	2	$200,000	$400,000
	Screening Conveyor	EA	1	$100,000	$100,000
	Gates & Motorized operator	EA	5	$15,000	$75,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
	Piping	LS	1	$50,000	$50,000
4	**Influent Pump Station**				**$0**
	Excavation & Backfill	CY	0	$125	$0
	Concrete Structure	CY	0	$1,000	$0
	Top Alum Cover	SQF	0	$30	$0
	Gates & Motorized operator	EA	0	$15,000	$0
	Instrumentation and electrical	LS	0	$70,000	$0
	Piping & Valves	LS	0	$80,000	$0
	Influent Turbine Pumps	EA	0	$80,000	$0
5	**One Clarifier - 120-FT diameter - Deeper**				**$4,978,000**
	Excavation & Backfill (within shoring)	CY	9,000	$25	$225,000
	Concrete Structure	CY	7,355	$600	$4,413,000

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City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 3 - SINGLE CLARIFIER $12,256,131

		Unit	QTY	Cost	Subtotal
	Clarifier Mechanical	LS	1	$250,000	$250,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
	Piping & Valves	LS	1	$50,000	$50,000
	Shoring: Excavation vertical cut protection	SQF	5,607	$28	$156,996
6	**Two Primary Sludge PS**				**$74,200**
	Concrete Pad	SQF	212	$100	$21,200
	Piping & Valves	LS	1	$12,000	$12,000
	Pumps	LS	2	$8,000	$16,000
	Instrumentation and electrical	LS	1	$25,000	$25,000
7	**Odor Control Facility**				**$268,000**
	Concrete Pad	SQF	280	$100	$28,000
	Equipment	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$50,000	$50,000
	Instrumentation and electrical	LS	1	$30,000	$30,000
8	**Degriting Facility**				**$375,000**
	Concrete Pad	SQF	700	$100	$70,000
	Galv Steel Structure	LS	1	$25,000	$25,000
	Cyclone	EA	2	$80,000	$160,000
	Piping & Valves	LS	1	$80,000	$80,000
	Instrumentation and electrical	LS	1	$40,000	$40,000
9	**Primary Electrical Building**				**$394,360**
	Concrete Pad	SQF	1,042	$80	$83,360
	Building	SQF	700	$80	$56,000
	MCC	LS	1	$85,000	$85,000
	Control Panels	LS	1	$50,000	$50,000
	Transformer, Service SCE	LS	1	$40,000	$40,000
	Modifications to SWGR-MSG	LS	1	$80,000	$80,000
10	**Existing Digester 2 (R=43') Dome Replacement**				**$982,000**

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 3 - SINGLE CLARIFIER $12,256,131

		Unit	QTY	Cost	Subtotal
	Dome removal	SQF	5,808	$40	$232,320
	Dome Replacement	SQF	5,808	$100	$580,800
	Repair & Recoat Walls	SQF	5,944	$20	$118,880
	Piping	LS	1	$50,000	$50,000
11	**PI pipe between IPS and Clarifiers**				**$63,802**
	36" STL	FT	146	$437	$63,802
12	**RS Pipe**				**$112,500**
	42" RCP	FT	225	$500	$112,500
13	**PSL Pipe**				**$60,000**
	DI	FT	200	$300	$60,000
14	**SSL Pipe**				**$21,250**
	8" DI	FT	50	$200	$10,000
	8" PVC Temp	FT	75	$150	$11,250
15	**PE Pipe**				**$217,400**
	48" STL	FT	368	$550	$202,400
	MH	EA	3	$5,000	$15,000
16	**PRF Pipe**				**$167,000**
	24" DI	FT	330	$400	$132,000
	MH	EA	7	$5,000	$35,000
17	**Other Small Piping**				**$500,000**
	Drain	LS	1	$300,000	$300,000
	PW	LS	1	$200,000	$200,000
18	**Other Small Equipment**				**$400,000**
	Small Equipment	LS	1	$400,000	$400,000
19	**Other Miscellaneous concrete**				**$300,000**

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BUILDING A BETTER WORLD

City of Palm Springs / WWTP Headworks and Primary Clarifiers Upgrade

Order of Magnitude Cost Estimate

OPTION 3 - SINGLE CLARIFIER $12,256,131

		Unit	QTY	Cost	Subtotal
	Miscellaneous Concrete	LS	1	$300,000	$300,000
20	**Roads**				**$744,000**
	Curb & Gutters, Galv Steel Grating	LS	1	$120,000	$120,000
	Grading & 12" Base & Asphalt Paving	SQY	4,160	$150	$624,000
	Total				**$11,141,937**
	Contingency 10% for Order of Magnitude approach				$1,114,193.70
	TOTAL				**$12,256,131**