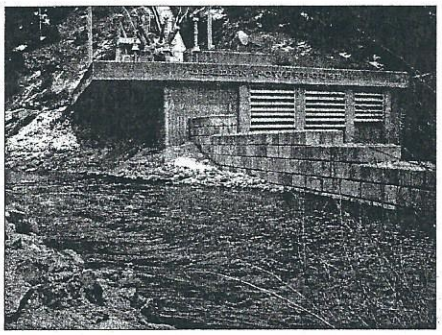

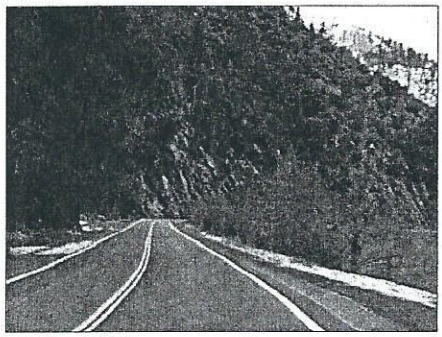

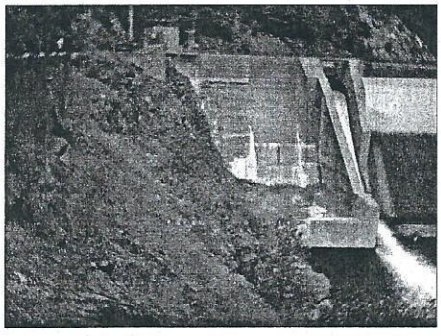

# NORTH FORK FEATHER RIVER YELLOW CREEK DIVERSION COOLING WATER PIPELINE FEASIBILITY STUDY

# SUMMARY REPORT

*Pacific Gas and Electric Company*
Hydro Generation

**FINAL**

February 18, 2005

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## 1.0 INTRODUCTION

The objective of this study is to determine the feasibility of constructing a pipeline to convey cool water from Yellow Creek above its confluence with the North Fork Feather River (NFFR) to a point immediately below Rock Creek Dam in order to reduce the temperature of the NFFR.

During July and August the stream flows in Yellow Creek just above its confluence with the NFFR are approximately 50 cubic feet per second. The measured mean water temperature for July and August 2003 was 15 to 16°C. For this study, it will be assumed that 50 cubic feet per second at 16°C of Yellow Creek water is diverted. Below Rock Creek Dam the water is discharged to mix with existing river flow of 200 cubic feet per second at 22°C. The 22°C river water temperature represents the existing August 25% exceedance water temperature. The mixing of 50 cubic feet per second at 16°C Yellow Creek water with 200 cubic feet per second at 22°C Rock Creek Reservoir released water will result in 250 cubic feet per second of 20.8°C water at the mixing point, a reduction of 1.2°C in the water temperature below Rock Creek Dam.

## 2.0 SITING CONSIDERATIONS

If constructed above grade, the 3-mile pipeline and valve equipment would need to be sited above the flood plain. A diversion dam and pipeline intake would be sized to withstand large flood flows from Yellow Creek. Visual impacts of the pipeline and diversion dam would need to be considered. Pipeline construction in the NFFR canyon would have significant engineering, construction, and environmental challenges. Major disruption of Highway 70 traffic would be expected during construction. Also, underground telephone lines traverse along Highway 70 which could be disrupted during construction.

The pipeline route may be a combination of surface and underground pipeline following the Highway 70 alignment. Due to limited space, significant portions of the pipeline may need to be buried under Highway 70. Operation and maintenance of a large water pipeline above grade along Highway 70 would have failure risks from vehicle collisions, road maintenance equipment, and rock slides. Means to mitigate these risks will need to be considered. Refer to Figure No. 1 for an overview of the pipeline route.

## 3.0 SITE VISIT

Ken Leung (PG&E), Bruce Duncan (B&V), and Brian Friesz (B&V) visited the site on Thursday, January 13, 2005 to review the topography and site conditions and to determine the location for the diversion structure, the pipe routing, and the location of the discharge.

Based on this review, it was determined for the purpose of this study that the diversion structure would be located approximately 1300 feet upstream from the Yellow Creek Bridge. At this location the creek canyon is steeper and avoids one obvious location of

rock fall. (Referring to Photo 1, the diversion structure would be located at the bend in the creek near the leaning tree.) In addition, it is believed this location is at or above the road elevation, so the pipe will have positive slope throughout its length, but this must be verified as a part of the preliminary design process. To provide access to the diversion dam during construction and for cleaning of the trashrack, removal of accumulated debris, and installation and removal of flashboards, a one-lane access road would be constructed, beginning at the north gate of the Belden Powerhouse yard, crossing Yellow Creek on a bridge (refer to Photo 2), and ending at the diversion structure with a turn-around near its terminus (refer to Figure No. 2).

The pipe would be routed in a shallow trench following the contour of the west side of the creek canyon to Highway 70, where it would cross under the highway with concrete encasement. From this point it would follow and be located on the river side of the Highway 70 shoulder. The pipe would be protected from scour with grouted rip rap (refer to Photo 3 for an example of grouted rip rap).

In many locations the space between the shoulder and river is not sufficient and the pipe would be located in the shoulder (refer to Photo 4), and in some cases, even partially in the roadway (refer to Photo 5). For these sections, the pipe would be encased in concrete. In addition, guardrail exists in many locations (refer to Photo 6) and will have to be removed and reset. There are several drainage courses to be crossed; some with small (approximately 2 feet in diameter) culverts (refer to Photo 7), large (approximately 5 feet in diameter) culverts at Pauls Creek (refer to Photo 8) and Murphy Creek (refer to Photo 9), a box culvert at Indian Creek (refer to Photo 10), and a double-span bridge at Chips Creek (refer to Photo 11). In some cases the space between the top of the existing culvert and the surface may not be enough for the new pipe. In those instances, elliptical or box sections would be used with appropriate transitions. A box section was considered for this study. For the box culvert and bridge, the pipe will be independently supported at the abutments (and center pier location for double-span bridge) with an independent bridge structure to support the pipe (refer to Figure No. 4).

Just downstream from Rock Creek Dam the pipe would turn under the concrete structure adjacent to the highway and penetrate the exposed rock slope next to the dam. From there it would turn down and be routed down the slope to discharge into the existing spillway plunge pool (refer to Photo 12). A valve would be provided to control discharge and ensure positive pressure in the pipe. A stairway would be required to provide access from the dam to the valve operator.

Figure No. 1 shows a routing of the pipeline from the new diversion on Yellow Creek, along Highway 70, to its discharge below the Rock Creek Dam. The total pipe length is approximately 16,300 feet, or 3.1 miles. Figures No. 2 through 5 show the conceptual layouts, sections, and details of the new diversion dam, drainage (creeks and culverts) crossings, the discharge at Rock Creek Dam, and a typical pipeline section. The quantities developed to determine the estimated construction cost are based on the configuration presented in these figures.

## 6.0 FEASIBILITY

Implementation of this project will be extremely difficult and fraught with delays. Permitting will be an exceptionally difficult process. Challenges will come from many fronts. While the project is driven by an environmental demand to reduce the temperature of the NFFR, other interests will fight hard against disturbing Yellow Creek and the right bank of the NFFR. Highway users, both recreational and commercial, are likely to make strong and very public objections to the extensive stretches of one-lane passages required for the construction of the pipeline, particularly since the expected construction duration will last two years. Although the pipeline does not directly affect the Pacific Crest National Scenic Trail, trail users will have to cross the construction zone during construction of the stretch between Belden and Chips Creek.

## 7.0 OTHER CONSIDERATIONS

### 7.1 Cold Water Refuge

Yellow Creek water currently provides a localized cooling effect at the confluence with the NFFR. This provides some cold water refuge for fish in the immediate area. The diversion of Yellow Creek would eliminate this local cool water refuge at the confluence.

### 7.2 Fishway

The flow required for the fishway will reduce the net flow available for cooling use. Additional study will have to be performed to determine the minimum fishway flow required.

### 7.3 Temperature Rise

The pre-conceptual analysis did not consider the effect of heat gain due to friction nor to radiation. A calculation was made for this study and the temperature rise was found to be almost negligible; between 0.1 and 0.2°C. Most of the heat is radiated back into the air. The calculation was made assuming an ambient temperature of 90°F, water temperature of 15°C, a cover of 1 foot of grouted rip rap over a 3-foot diameter concrete pipe with wall thickness of 4 inches. If unlined steel pipe were used the rise would be higher, but because the grouted rip rap accounts for most of the insulating value, the additional gain would not be significant. For the heat gain calculations, refer to Appendix D.

## 8.0 REFERENCES

1. Design of Small Dams; Third Edition, 1987; United States Department of the Interior, Bureau of Reclamation.
2. Engineering Monograph No. 7, Friction Factors for Large Conduits Flowing Full, 1977; United States Department of the Interior, Bureau of Reclamation.

# PHOTOS

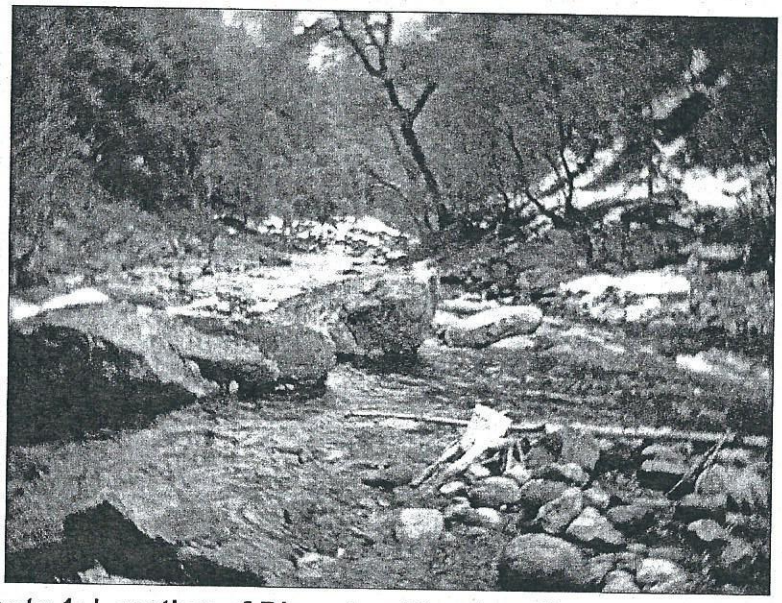


Photo 1: Location of Diversion Structure (looking upstream)

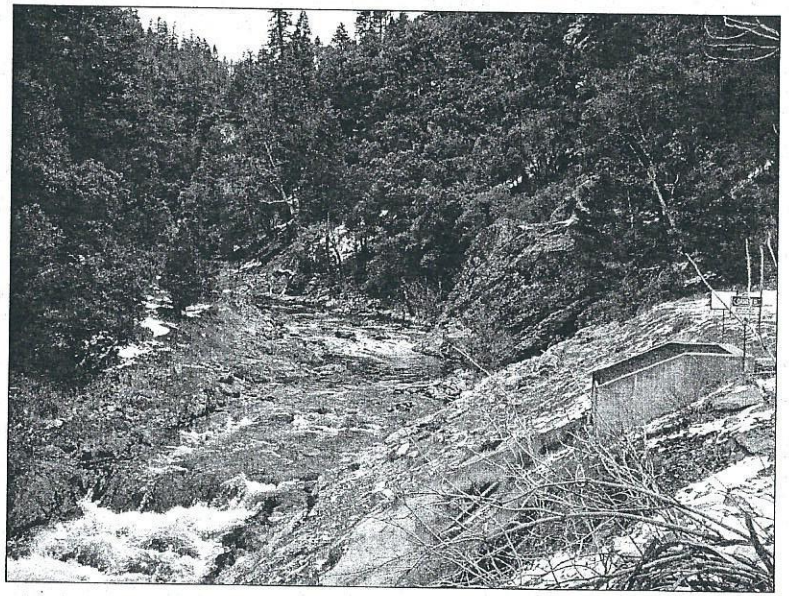


Photo 2: Location of Access Road Bridge (looking upstream)

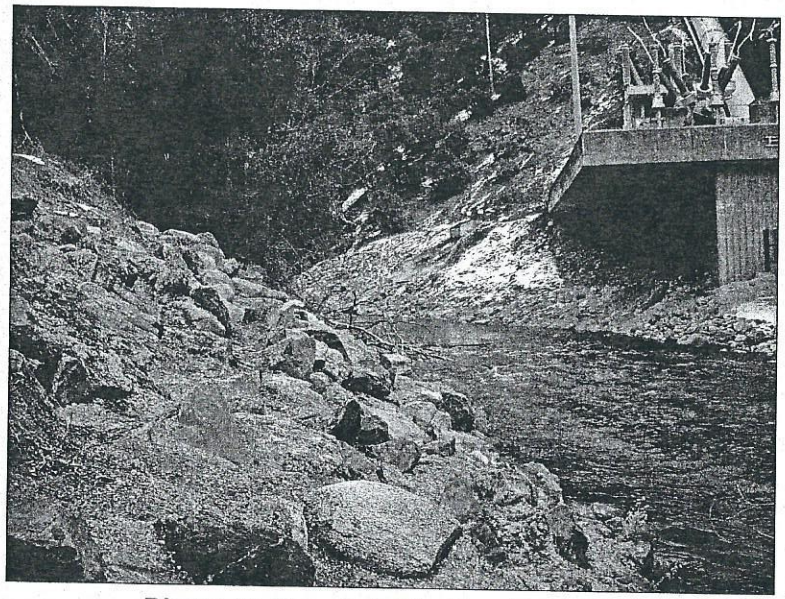


Photo 3: Grouted Rip Rap Example

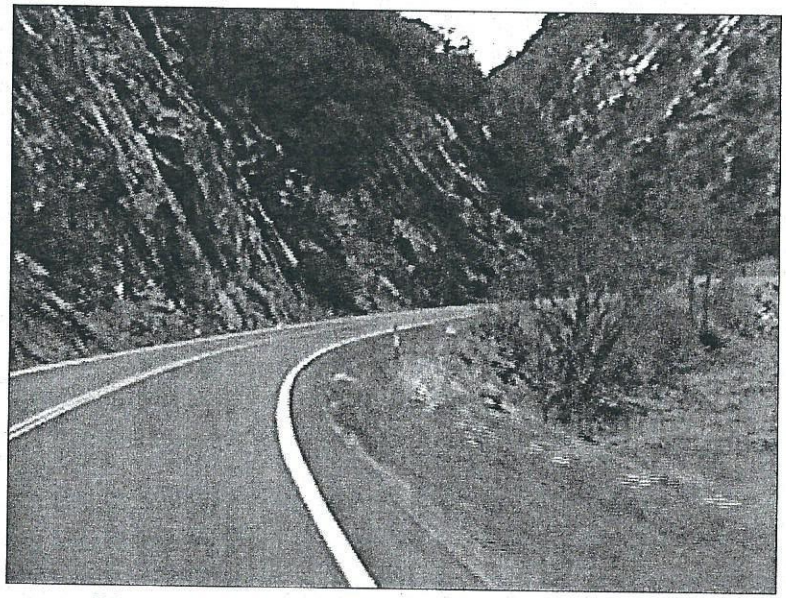


Photo 4: Highway 70 with Typical Shoulder

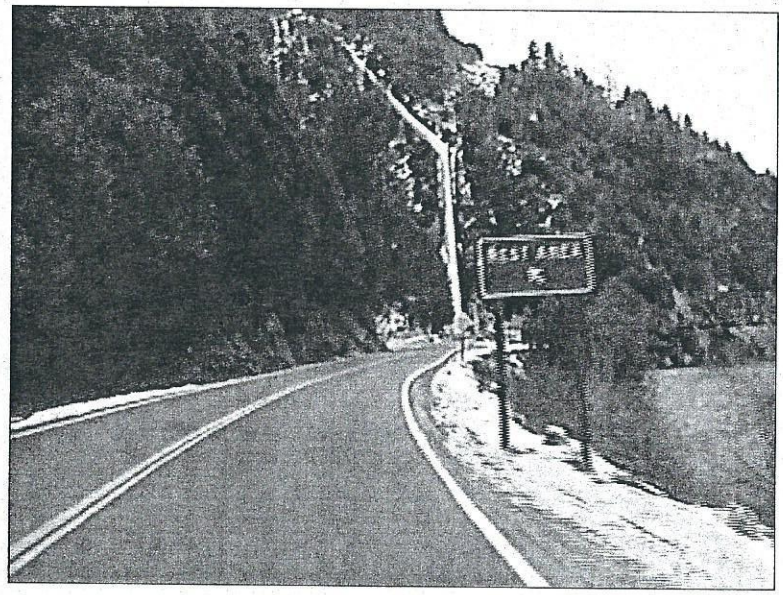


Photo 5: Highway 70 with Narrow Shoulder

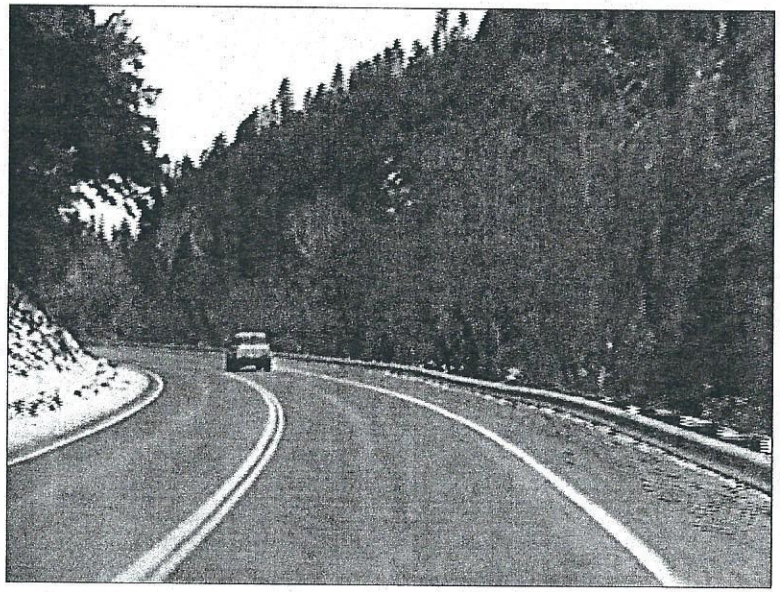


Photo 6: Highway 70 with Guardrail

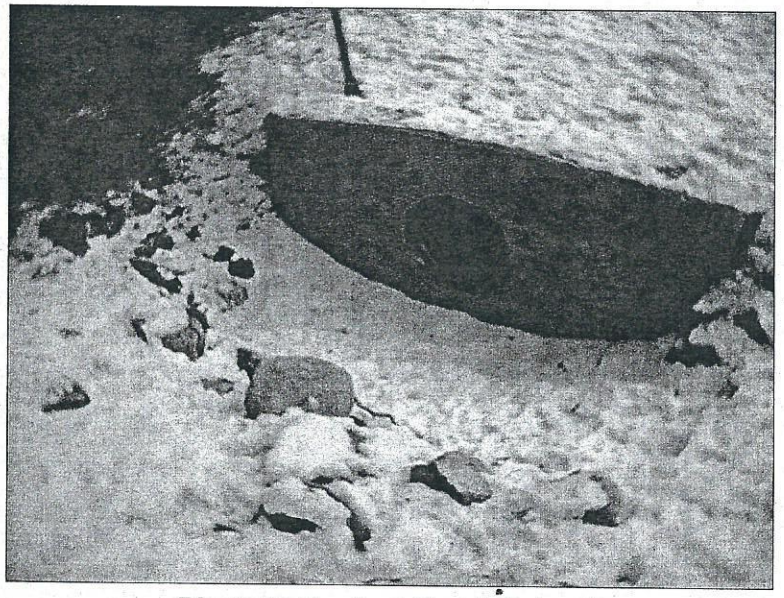


Photo 7: Typical Small Culvert

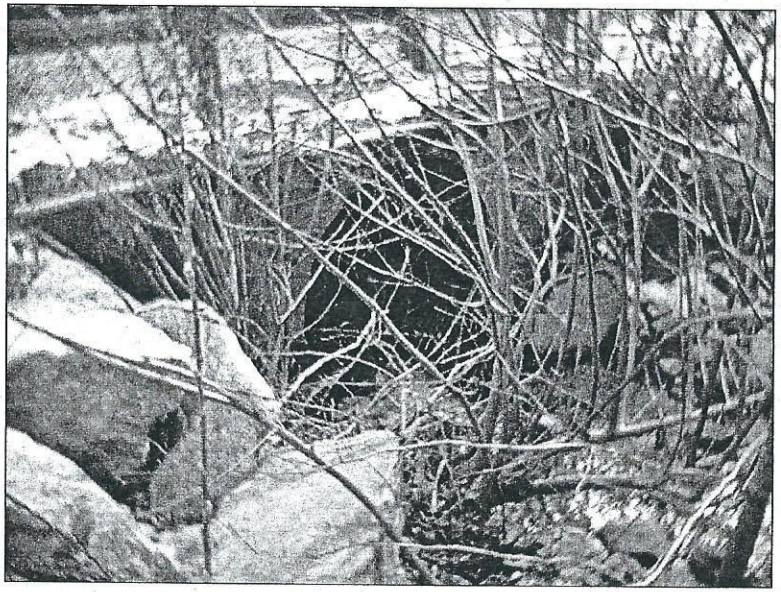


Photo 8: Large Culvert at Pauls Creek

Photo 9: Large Culvert at Murphy Creek

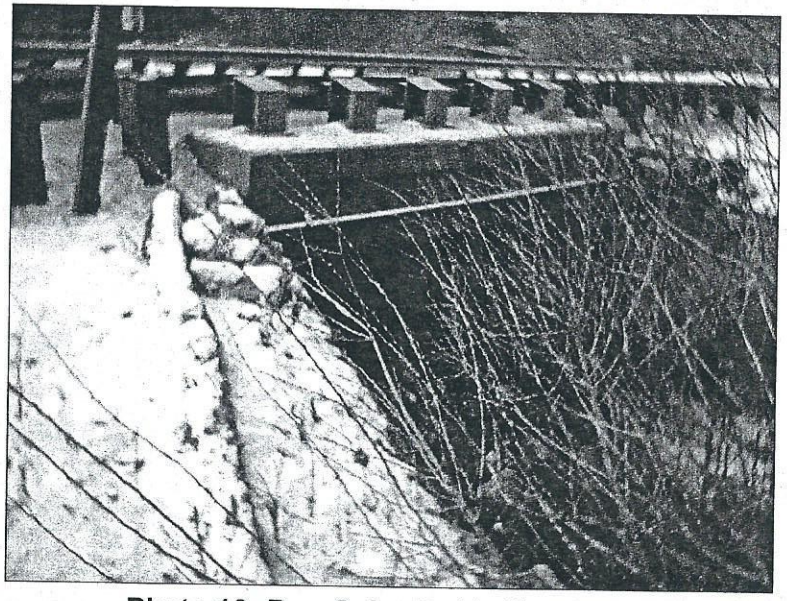


Photo 10: Box Culvert at Indian Creek

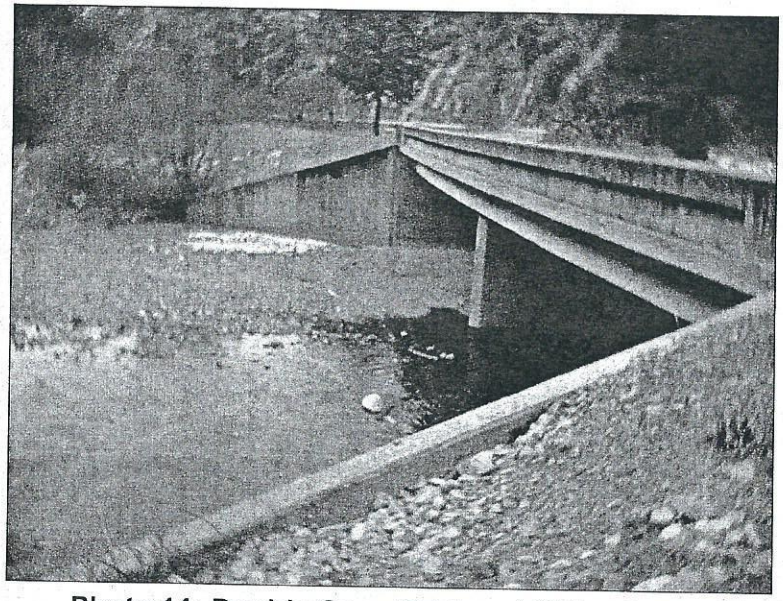


Photo 11: Double-Span Bridge at Chips Creek

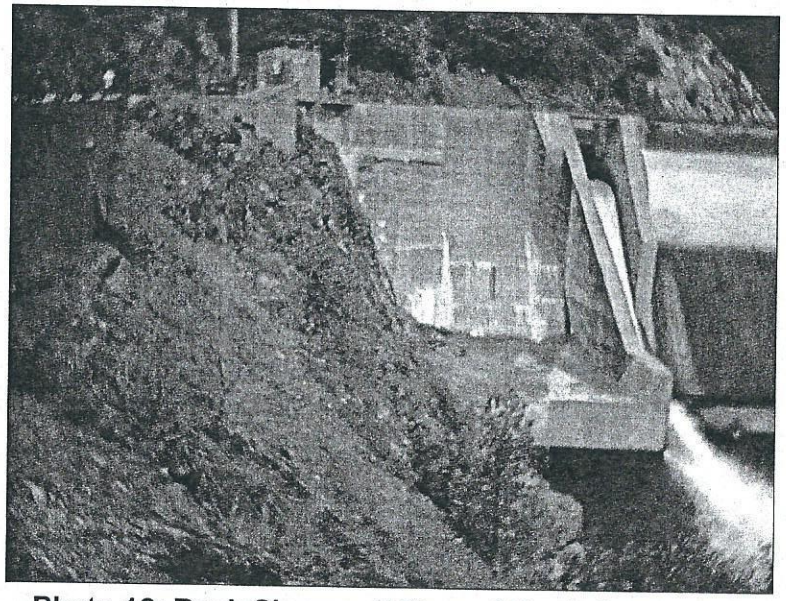
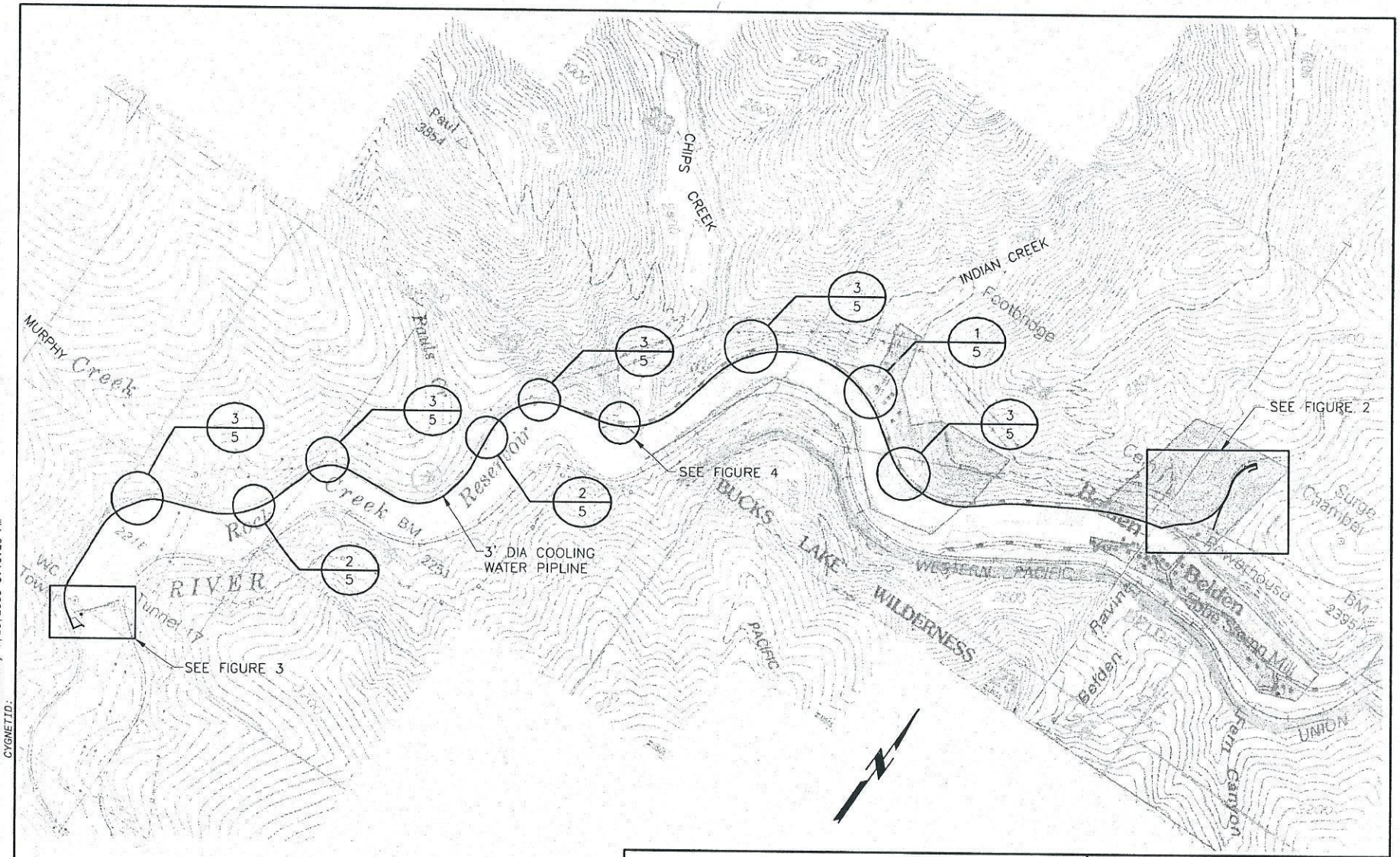


Photo 12: Rock Slope and Face of Rock Creek Dam

# FIGURES




PACIFIC GAS AND ELECTRIC COMPANY
YELLOW CREEK COOLING WATER PIPELINE STUDY
JANUARY 28, 2005

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FIGURE NO. 1

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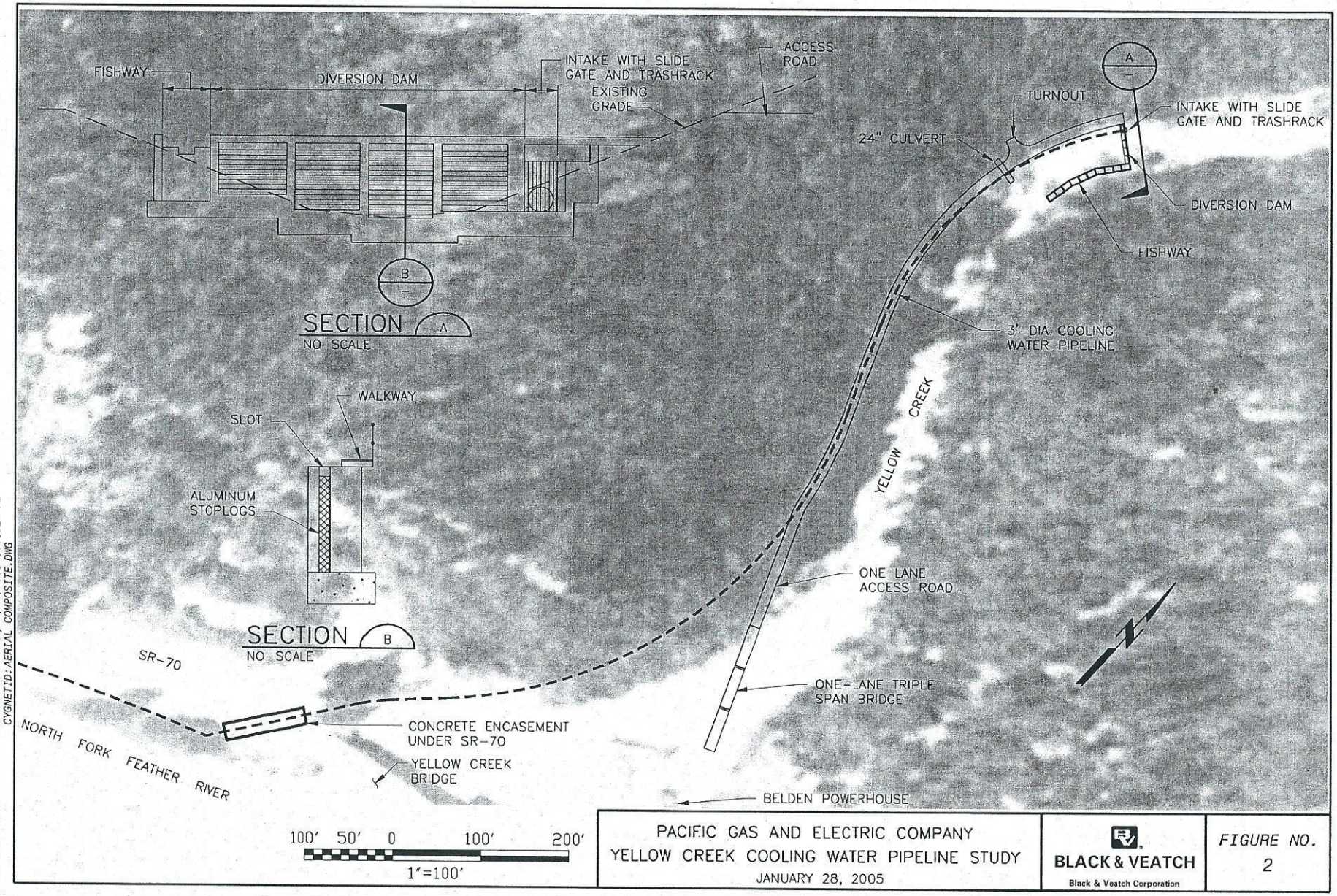


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FIGURE NO. 2

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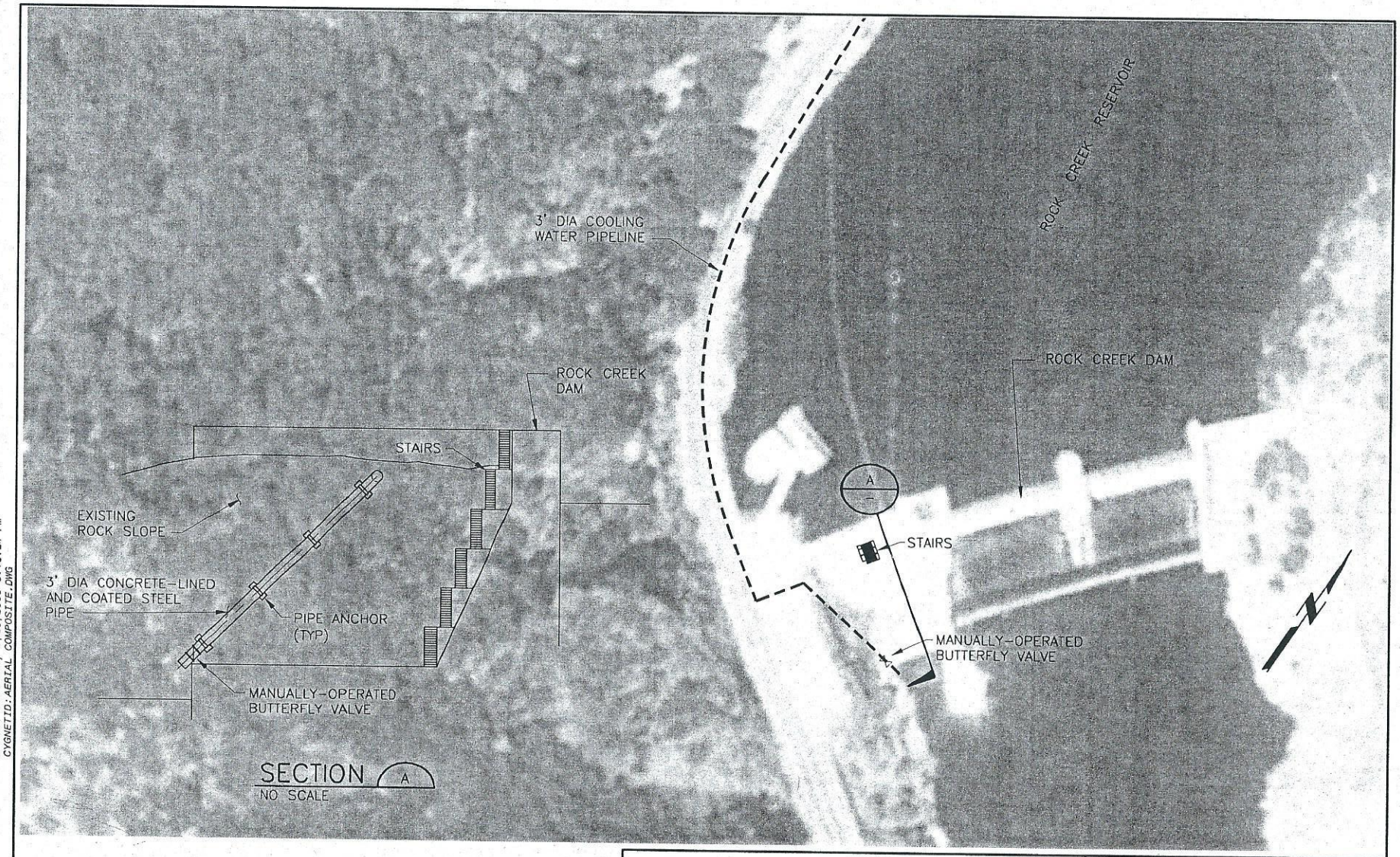


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JANUARY 28, 2005

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FIGURE NO. 3

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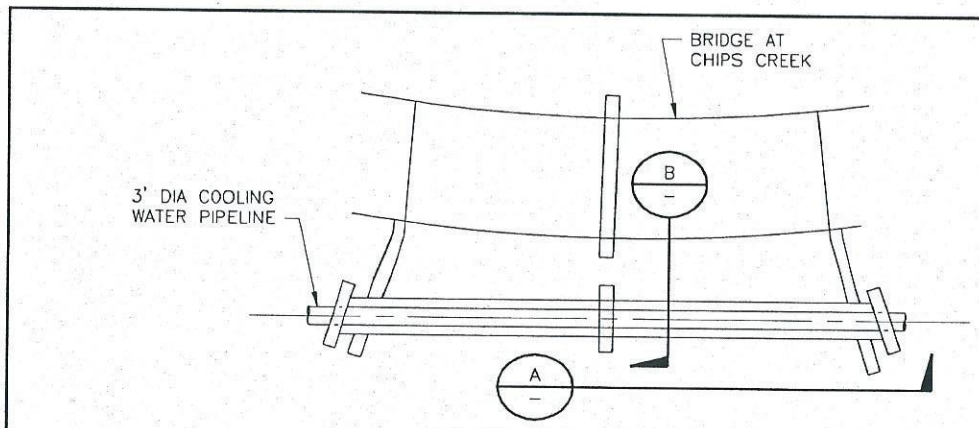
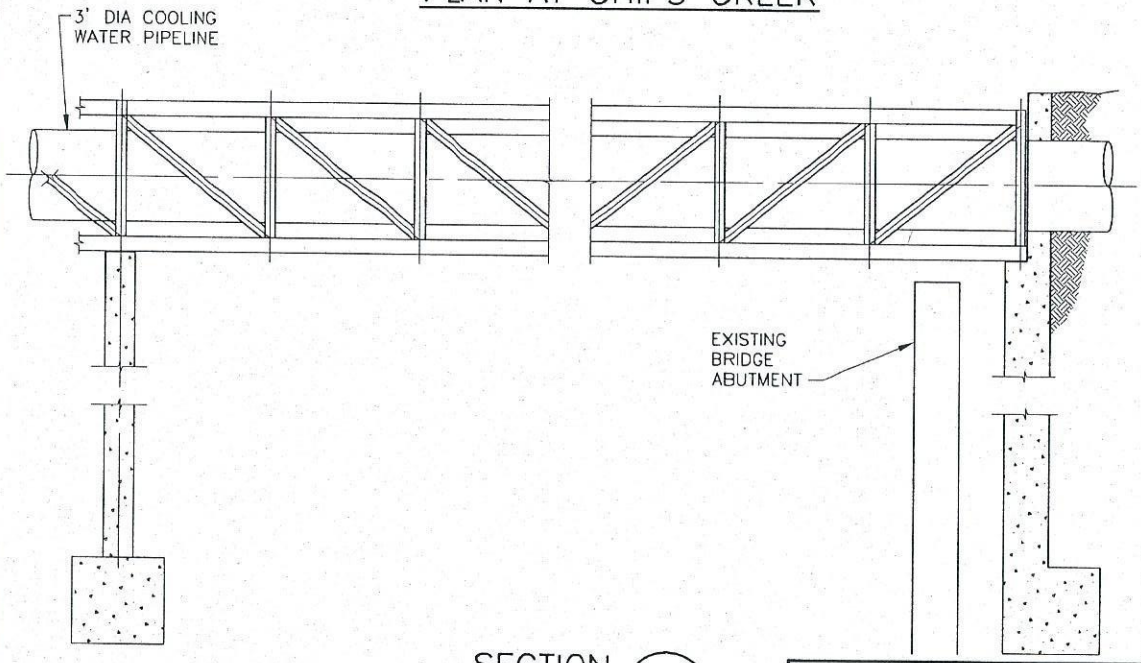
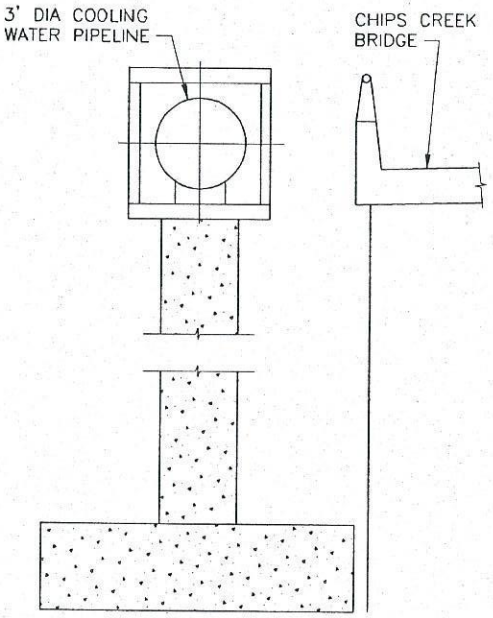



PLAN AT CHIPS CREEK




SECTION A
NO SCALE




SECTION A
NO SCALE

PACIFIC GAS AND ELECTRIC COMPANY
YELLOW CREEK COOLING WATER PIPELINE STUDY
JANUARY 28, 2005

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FIGURE NO.
4

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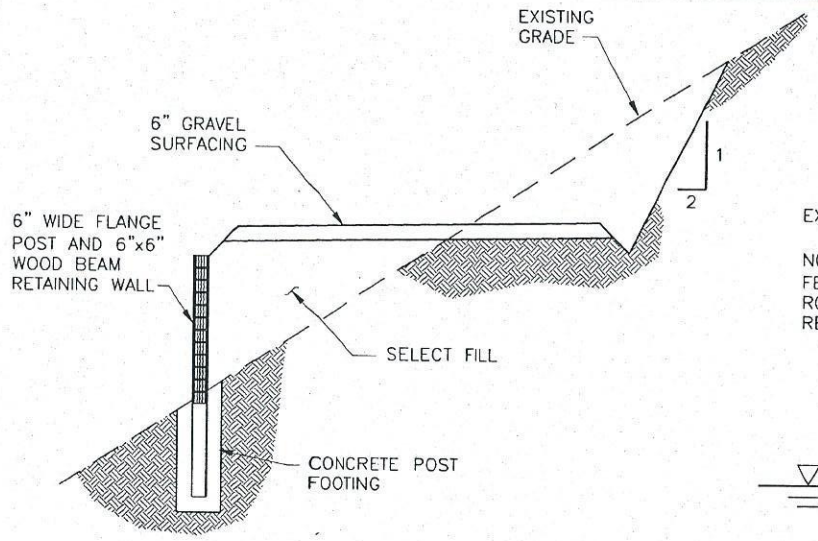


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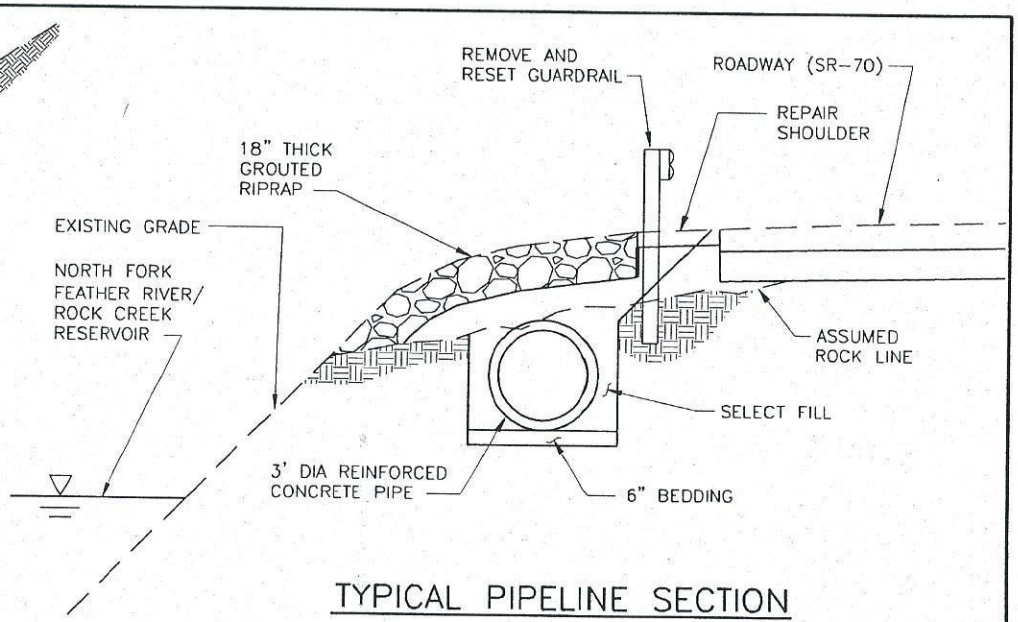
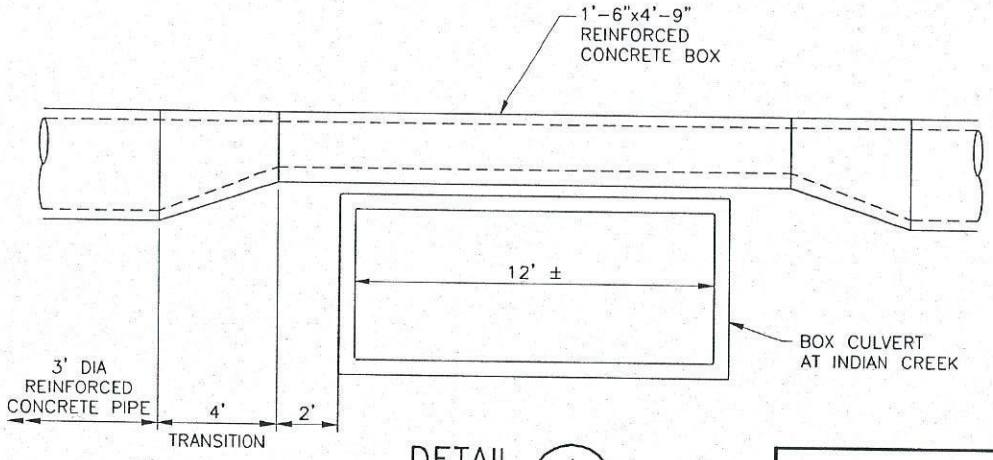



## TYPICAL PIPELINE SECTION




DETAIL 1/1
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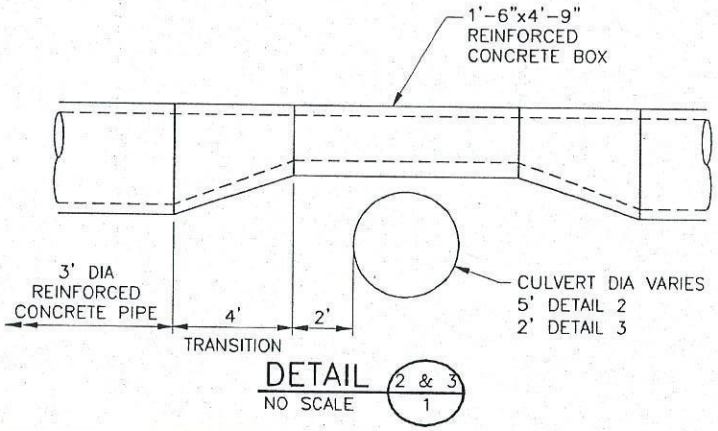


DETAIL 2 & 3/1
NO SCALE

PACIFIC GAS AND ELECTRIC COMPANY
YELLOW CREEK COOLING WATER PIPELINE STUDY
JANUARY 28, 2005

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FIGURE NO. 5

# APPENDICES

# *Appendix A – Hydraulic Analysis*

PG&E Contract No. 4600014656
CWA No. 3500602997
B&V Project No. 133626.0144

Pacific Gas and Electric
NFFR Yellow Creek Cooling Water Pipeline
Feasibility Study

# Determination of Pipe Diameter

## Assumptions[1]

| | |
|---|---|
| Flow (cfs) | **50** |
| Upstream WS el (ft) | **2235.0** |
| Downstream WS el (ft) | **2165.0** |
| Water temperature (°C) | **15** |
| Viscosity v ($ft^2/s$) | 1.25E-05 |
| Pipe Length (ft) | **16,260** |
| Pipe Roughness ∈ (ft) | **0.0005** |
| Diameter increment (ft) | **0.10** |

| Trashrack | | | |
|---|---|---|---|
| Bar Width (in) | **0.5** | Required Rack Size ($ft^2$ | 16.7 |
| Clear Spacing (in) | **2.0** | Rack Height (ft) | **6.00** |
| Approach Velocity (ft/s) | **3.00** | Rack Width (ft) | 2.78 |
| C: | **0.65** | Effective Area (ft) | 13.3 |
| Net Velocity (ft/s) | 3.75 | $h_{L\ TRASHRACK}$ (ft) | 0.12 |

| Bends | angle (deg): | k | qty |
|---|---|---|---|
| $R_b/D$ | **11.25** | 0.037 | **59** |
| **1.5** | **22.5** | 0.066 | **7** |
| | **45** | 0.116 | **2** |
| | **70** | 0.148 | **1** |
| | 90 | 0.166 | **1** |

| Transitions | k | qty |
|---|---|---|
| Expansions | **0.100** | **9** |
| Contractions | **0.000** | 9 |

## Hydraulic Capacity Calculation

| Pipe Diameter (ft) | Area (ft) | Pipe Velocity (ft/s) | Summary: Required Submergence (ft) | Summary: Maximum Inlet Elev | Summary: Outlet Elev (ft) | Summary: Pipe Slope (ft/ft) | Summary: Available Head (ft) | Summary: Head Loss $(ft)^2$ | Vortex: Required Submergence (ft) C: **2.2** | Entrance: $h_{L\ ENTRANCE}$ (ft) k: **0.2** | Bend: $h_{L\ BEND}$ (ft) | Transitions: $h_{L\ TRANSITIONS}$ (ft) | Pipe: R | Pipe: ∈/d | Pipe: f | Pipe: $h_{L\ PIPE}$ (ft) | Valve: $h_{L\ VALVE}$ (ft) k: **0.2** | Exit: $h_{L\ EXIT}$ (ft) k: **1** | Total Losses (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.50** | 4.91 | 10.19 | 6.2 | 2227.51 | 2167.25 | 0.0037 | 67.8 | ***158.1*** | 6.2 | 0.32 | 5.10 | 1.45 | 2.04E+06 | 0.000200 | 0.01423 | 149.12 | 0.32 | 1.61 | 158.06 |
| 2.60 | 5.31 | 9.42 | 5.9 | 2227.81 | 2167.30 | 0.0037 | 67.7 | ***129.6*** | 5.9 | 0.28 | 4.36 | 1.24 | 1.96E+06 | 0.000192 | 0.01416 | 121.92 | 0.28 | 1.38 | 129.57 |
| 2.70 | 5.73 | 8.73 | 5.6 | 2228.09 | 2167.35 | 0.0037 | 67.7 | ***107.1*** | 5.6 | 0.24 | 3.75 | 1.07 | 1.89E+06 | 0.000185 | 0.01409 | 100.45 | 0.24 | 1.18 | 107.05 |
| 2.80 | 6.16 | 8.12 | 5.3 | 2228.33 | 2167.40 | 0.0037 | 67.6 | ***89.1*** | 5.3 | 0.20 | 3.24 | 0.92 | 1.82E+06 | 0.000179 | 0.01402 | 83.37 | 0.20 | 1.02 | 89.09 |
| 2.90 | 6.61 | 7.57 | 5.0 | 2228.55 | 2167.45 | 0.0038 | 67.6 | ***74.6*** | 5.0 | 0.18 | 2.82 | 0.80 | 1.76E+06 | 0.000172 | 0.01396 | 69.66 | 0.18 | 0.89 | 74.64 |
| 3.00 | 7.07 | 7.07 | 4.7 | 2228.75 | 2167.50 | 0.0038 | 67.5 | 62.9 | 4.7 | 0.16 | 2.46 | 0.70 | 1.70E+06 | 0.000167 | 0.01391 | 58.57 | 0.16 | 0.78 | 62.94 |
| 3.10 | 7.55 | 6.62 | 4.5 | 2228.93 | 2167.55 | 0.0038 | 67.4 | 53.4 | 4.5 | 0.14 | 2.16 | 0.61 | 1.64E+06 | 0.000161 | 0.01386 | 49.53 | 0.14 | 0.68 | 53.38 |
| 3.20 | 8.04 | 6.22 | 4.3 | 2229.09 | 2167.60 | 0.0038 | 67.4 | 45.5 | 4.3 | 0.12 | 1.90 | 0.54 | 1.59E+06 | 0.000156 | 0.01381 | 42.12 | 0.12 | 0.60 | 45.52 |
| 3.30 | 8.55 | 5.85 | 4.1 | 2229.23 | 2167.65 | 0.0038 | 67.3 | 39.0 | 4.1 | 0.11 | 1.68 | 0.48 | 1.54E+06 | 0.000152 | 0.01377 | 36.00 | 0.11 | 0.53 | 39.02 |
| 3.40 | 9.08 | 5.51 | 3.9 | 2229.36 | 2167.70 | 0.0038 | 67.3 | 33.6 | 3.9 | 0.09 | 1.49 | 0.42 | 1.50E+06 | 0.000147 | 0.01373 | 30.92 | 0.09 | 0.47 | 33.62 |
| 3.50 | 9.62 | 5.20 | 3.8 | 2229.48 | 2167.75 | 0.0038 | 67.3 | 29.1 | 3.8 | 0.08 | 1.33 | 0.38 | 1.46E+06 | 0.000143 | 0.01369 | 26.68 | 0.08 | 0.42 | 29.09 |
| 3.60 | 10.18 | 4.91 | 3.6 | 2229.59 | 2167.80 | 0.0038 | 67.2 | 25.3 | 3.6 | 0.07 | 1.19 | 0.34 | 1.41E+06 | 0.000139 | 0.01366 | 23.12 | 0.07 | 0.37 | 25.29 |
| 3.70 | 10.75 | 4.65 | 3.5 | 2229.68 | 2167.85 | 0.0038 | 67.2 | 22.1 | 3.5 | 0.07 | 1.06 | 0.30 | 1.38E+06 | 0.000135 | 0.01363 | 20.11 | 0.07 | 0.34 | 22.07 |
| 3.80 | 11.34 | 4.41 | 3.3 | 2229.77 | 2167.90 | 0.0038 | 67.1 | 19.3 | 3.3 | 0.06 | 0.96 | 0.27 | 1.34E+06 | 0.000132 | 0.01360 | 17.56 | 0.06 | 0.30 | 19.34 |
| 3.90 | 11.95 | 4.19 | 3.2 | 2229.85 | 2167.95 | 0.0038 | 67.1 | 17.0 | 3.2 | 0.05 | 0.86 | 0.25 | 1.31E+06 | 0.000128 | 0.01358 | 15.40 | 0.05 | 0.27 | 17.00 |
| 4.00 | 12.57 | 3.98 | 3.1 | 2229.91 | 2168.00 | 0.0038 | 67.0 | 15.0 | 3.1 | 0.05 | 0.78 | 0.22 | 1.27E+06 | 0.000125 | 0.01355 | 13.54 | 0.05 | 0.25 | 15.01 |
| 4.10 | 13.20 | 3.79 | 3.0 | 2229.98 | 2168.05 | 0.0038 | 66.9 | 13.3 | 3.0 | 0.04 | 0.71 | 0.20 | 1.24E+06 | 0.000122 | 0.01353 | 11.95 | 0.04 | 0.22 | 13.29 |
| 4.20 | 13.85 | 3.61 | 2.9 | 2230.03 | 2168.10 | 0.0038 | 66.9 | 11.8 | 2.9 | 0.04 | 0.64 | 0.18 | 1.21E+06 | 0.000119 | 0.01351 | 10.58 | 0.04 | 0.20 | 11.81 |
| 4.30 | 14.52 | 3.44 | 2.8 | 2230.08 | 2168.15 | 0.0038 | 66.8 | 10.5 | 2.8 | 0.04 | 0.58 | 0.17 | 1.18E+06 | 0.000116 | 0.01349 | 9.39 | 0.04 | 0.18 | 10.52 |
| 4.40 | 15.21 | 3.29 | 2.7 | 2230.13 | 2168.20 | 0.0038 | 66.8 | 9.4 | 2.7 | 0.03 | 0.53 | 0.15 | 1.16E+06 | 0.000114 | 0.01348 | 8.36 | 0.03 | 0.17 | 9.40 |
| 4.50 | 15.90 | 3.14 | 2.6 | 2230.16 | 2168.25 | 0.0038 | 66.8 | 8.4 | 2.6 | 0.03 | 0.49 | 0.14 | 1.13E+06 | 0.000111 | 0.01346 | 7.47 | 0.03 | 0.15 | 8.43 |

[1] **XXX** Indicates input value.
[2] ***XXX*** Indicates head loss exceeds available head.

# *Appendix B – Costs*

**PG&E**

**Project:** Yellow Creek Water Pipe Line Open Trenching
**Project No.:** 136962.0144
**Revision No.:** 7
**Date:** 02/10/05

## Opinion Of Probable Cost

**Pipeline Trenching**

| Item No. | Description | Quantity | Unit | Unit Price | Price Total |
|---|---|---|---|---|---|
| 1 | General Requirements | | | | |
| | Mobilization & Demobilization | 1 | LS | 50,260 | 50,260 |
| | Site Indirects | 1 | LS | 1,431,457 | 1,431,457 |
| 2 | Dam, Fishway, Trashrack, and Road | 1 | LS | 776,722 | 776,722 |
| 3 | Bridge (Over Yellow Creek) | 1 | LS | 2,307,127 | 2,307,127 |
| 4 | Pipe - Diversion Dam To SR-70 | 1 | LS | 244,487 | 244,487 |
| 5 | Pipe - Along Road SR-70 | 1 | LS | 6,652,101 | 6,652,101 |
| 6 | Rock Creek Dam To Discharge | 1 | LS | 379,901 | 379,901 |
| | **Construction Subtotal (Direct Costs)** | | | | **$11,842,055** |
| | **Indirect Costs** | | | | |
| | General Requirements | 0% | of construction cost ( included in General Requirements) | | 0 |
| | Sales Tax | 8% | of purchased materials | | 382,544 |
| | Ocean Shipping | 0% | of purchased off-shore materials | | 0 |
| | Ocean Shipping | 0% | of purchased off-shore Rental Equipment | | 0 |
| | Overhead and Profit | 12% | of construction cost + general requirements | | 1,421,047 |
| | Bonds and Insurance | 4% | of construction cost + general requirements + sales tax + overhead and profit | | 545,826 |
| | Escalation | 9.15% | of construction cost | | 1,298,520 |
| | Contingency | 50% | of construction cost + general conditions + sales tax + overhead and profit + bonds and insurance + escalation | | 7,744,995 |
| | **Construction Subtotal Indirects** | | | | **$11,392,931** |
| | **Total Construction (directs and indirects)** | | | | **$23,234,986** |
| | **Permits** | 10% | of construction cost | | **$2,323,499** |
| | **Design** | 10% | of construction cost | | **$2,323,499** |
| | **Construction Management** | 10% | of construction cost | | **$2,323,499** |
| | **PG&E** | | | | |
| | **Owner Admin. & Overhead** | 5.5% | of construction cost + permits + design + construction management | | **$1,661,302** |
| | **FCFFDC** | 23.0% | of constr. cost + permits + design + constr. mgt +PG&E owner admin. & overhead | | **$7,329,360** |
| | **Total** | | | | **$39,196,144** |

**PG&E**

Project: Yellow Creek Water Pipe Line Open Trenching
Project No. 136962.0144
Revision No.: 7
Date: 02/10/05

## Opinion Of Probable Cost

### Pipeline Trenching

| CSI Div. | DESCRIPTION | Quantity | Unit | Unit Cost | Man-Hours | Labor Cost | Material Cost | Equipment Cost | Subcontract Cost | Other Cost | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **General Requirements** | | | | | | | | | | |
| | Mobilization | | | | 0 | 0 | 0 | 0 | 0 | 26,026 | 26,026 |
| | Site Indirects | | | | 0 | 0 | 0 | 0 | 0 | 1,405,431 | 1,405,431 |
| | Subtotal General Requirements | | | | 0 | $0 | $0 | $0 | $0 | $1,431,457 | $1,431,457 |
| 2 | **Site Work** | | | | | | | | | | |
| | Site Work | | | | 69,973 | 4,863,652 | 2,811,210 | 1,761,222 | 240,000 | 168,333 | 9,844,417 |
| | Subtotal Site Construction | | | | 69,973 | $4,863,652 | $2,811,210 | $1,761,222 | $240,000 | $168,333 | $9,844,417 |
| 3 | **Concrete** | | | | | | | | | | |
| | Materials & Methods | | | | 2,931 | 171,073 | 35,398 | 21,630 | 0 | 0 | 228,100 |
| | Subtotal Concrete | | | | 2,931 | $171,073 | $35,398 | $21,630 | $0 | $0 | $228,100 |
| 5 | **Metals** | | | | | | | | | | |
| | Materials & Methods | | | | 2,189 | 185,744 | 117,522 | 34,815 | 0 | 0 | 338,081 |
| | Subtotal Metals | | | | 2,189 | $185,744 | $117,522 | $34,815 | $0 | $0 | 0<br>$338,081 |
| | **Construction Subtotal (Direct Costs)** | | | | 75,094 | $5,220,469 | $2,964,130 | $1,817,667 | $240,000 | $1,599,790 | $11,842,055 |

| | | | |
|---|---|---|---|
| **Indirect Costs** | | | |
| General Requirements | 0% | of construction cost ( included in Division 1) | 0 |
| Sales Tax | 8% | of purchased materials | 382,544 |
| Ocean Shipping | 0% | of purchased off-shore materials | 0 |
| Ocean Shipping | 0% | of purchased off-shore Rental Equipment | 0 |
| Overhead and Profit | 12% | of construction cost + general requirements | 1,421,047 |
| Bonds and Insurance | 4% | of construction cost + general requirements + sales tax + overhead and profit | 545,826 |
| Escalation (FY2010) | 9.15% | of construction cost + general conditions + sales tax + overhead and profit + bonds and insurance | 1,298,520 |
| Contingency | 50% | of construction cost + general conditions + sales tax + overhead and profit + bonds and insurance + escalation | 7,744,995 |
| **Construction Subtotal Indirects** | | | $11,392,931 |
| **Total Construction (directs and indirects)** | | | $23,234,986 |
| **Permits** | 10% | of construction cost | 2,323,499 |
| **Design** | 10% | of construction cost | 2,323,499 |
| **Construction Management** | 10% | of construction cost | 2,323,499 |
| **PG&E** | | | |
| **Owner Admin. & Overhead** | 5.5% | of construction cost + permits + design + construction management | 1,661,302 |
| **FCFFDC** | 23.0% | of constr. cost + permits + design + constr. management +PG&E owner admin. & overhead | 7,329,360 |
| **Total** | | | $39,196,144 |

**PG&E**

**Project:** Yellow Creek Water Pipe Line Open Trenching
**Project No.** 136962.0144
**Revision No.:** 7
**Date:** 02/10/05

## Opinion Of Probable Cost

**Pipeline Trenching**

| CSI Div. / Sect. | DESCRIPTION | Quantity | Unit | Unit Cost | Labor: Crew Code | Labor: M-H per Unit | Labor: Man Hours | Labor: Duration Days | Labor: Average Wage Rate | Labor: Labor Cost | Material: Unit Cost | Material: Material Cost | Equipment: Code | Equipment: No. | Equipment: Avg. Cost ($/hr) | Equipment: Equipment Cost | Sub-contract | Other | Total Cost | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | General Requirements | | | | | | | | | | | | | | | | | | | |
| | Mobilization | 1 | LS | 26,026 | | | | | | 0.00 | | 0.00 | | | | | | 26,026 | 26,026 | |
| | Supervision | 1 | LS | 520,530 | | | | | | 0.00 | | 0.00 | | | | | | 520,530 | 520,530 | |
| | Temporary construction facilities | 1 | LS | 260,265 | | | | | | 0.00 | | 0.00 | | | | | | 260,265 | 260,265 | |
| | Temporary utilities | 1 | LS | 156,159 | | | | | | 0.00 | | 0.00 | | | | | | 156,159 | 156,159 | |
| | Safety | 1 | LS | 260,265 | | | | | | 0.00 | | 0.00 | | | | | | 260,265 | 260,265 | |
| | Miscellaneous | 1 | LS | 208,212 | | | | | | 0.00 | | 0.00 | | | | | | 208,212 | 208,212 | |
| | Subtotal Mobilization | | | | | | | | | 0 | | 0 | | | | 0.00 | 0 | 1,431,457 | 1,431,457 | |
| 2 | Site Work | | | | | | | | | | | | | | | | | | | |
| 02050 | Basic Site Materials & Methods | | | | | | | | | | | | | | | | | | | |
| 02060 | Aggregate | | | | | | | | | | | | | | | | | | | |
| | Borrow | | | | | | | | | | | | | | | | | | | |
| 2 | Crushed Stone 1/2" | 171 | CY | 33.09 | C6 | 0.047 | 8 | 0.3 | 73.27 | 588.84 | 26.50 | 4,531.50 | 3f | 3 | 66.90 | 537.66 | | 0 | 5,658 | |
| | Select Structure Fill | 0 | CY | 0.00 | C6 | 0.047 | 0 | 0.0 | 73.27 | 0.00 | 7.90 | 0.00 | 3f | 3 | 66.90 | 0.00 | | 0 | 0 | |
| 2 | Hauling (50 Miles) | 205 | CY | 5.05 | C1 | 0.052 | 11 | 1.3 | 71.88 | 766.96 | | 0.00 | 3e | 2 | 25.23 | 269.16 | | 0 | 1,036 | |
| 02080 | Utility Materials | | | | | | | | | | | | | | | | | | | |
| | Valves | | | | | | | | | | | | | | | | | | | |
| | Butterfly | | | | | | | | | | | | | | | | | | | |
| 6 | 36" Dia. (Manuel Operator) | 1 | EA | 10,297.47 | B4 | 84.000 | 84 | 2.6 | 63.30 | 5,317.47 | 4,500.00 | 4,500.00 | | | 480.00 | 480.00 | | 0 | 10,297 | |
| | Gate | | | | | | | | | | | | | | | | | | | |
| 2 | 36" Dia. Slide Gate | 1 | EA | 5,840.81 | B4 | 35.556 | 36 | 1.1 | 63.30 | 2,250.81 | 2,950.00 | 2,950.00 | | | 640.00 | 640.00 | | 0 | 5,841 | |
| 02225 | Site Demolition | | | | | | | | | | | | | | | | | | | |
| 5 | Remove & Reset Guider (Steel) | 12,940 | LF | 53.21 | A3 | 0.805 | 10,417 | 434.0 | 58.08 | 605,033.19 | 0.00 | 0.00 | | | 6.45 | 83,482.41 | | 0 | 688,516 | |
| | Remove Pavement & Curb | | | | | | | | | | | | | | | | | | | |
| 5 | Remove Gravel Shoulder | 3,989 | SY | 5.92 | B4d | 0.067 | 266 | 6.7 | 68.13 | 18,127.15 | 0.00 | 0.00 | | | 1.38 | 5,504.82 | | 0 | 23,632 | |
| | Disposal | | | | | | | | | | | | | | | | | | | |
| | Dump Charges | | | | | | | | | | | | | | | | | | | |
| | Rubbish Handling | | | | | | | | | | | | | | | | | | | |
| 5 | 20 Mile Round Trip 0.4 Loads/Hr. | 1,356 | CY | 35.04 | C1 | 0.267 | 361 | 45.2 | 71.88 | 25,965.97 | 0.00 | 0.00 | 3d1 | 1 | 59.62 | 21,536.85 | | 0 | 47,503 | |
| 02230 | Site Clearing | | | | | | | | | | | | | | | | | | | |
| | Clear & Curb | | | | | | | | | | | | | | | | | | | |
| 3 | Dozer - 300 HP | 31 | SY | 5.45 | B2 | 0.050 | 2 | 0.1 | 81.63 | 126.53 | 0.00 | 0.00 | 6c | 1 | 54.73 | 42.42 | | 0 | 169 | |
| 5 | Dozer - 300 HP | 9,768 | SY | 5.45 | B2 | 0.050 | 488 | 30.5 | 81.63 | 39,869.80 | 0.00 | 0.00 | 6c | 1 | 54.73 | 13,365.85 | | 0 | 53,236 | |
| | Select Tree Removal | | | | | | | | | | | | | | | | | | | |
| 2 | Trees Up To 36" | 19 | EA | 1,112.48 | B4e | 13.333 | 247 | 6.2 | 66.71 | 16,490.99 | 0.00 | 0.00 | | | 223.00 | 4,134.42 | | 0 | 20,625 | |
| 4 | Trees Up To 36" | 16 | EA | 1,112.48 | B4e | 13.333 | 209 | 5.2 | 66.71 | 13,973.76 | 0.00 | 0.00 | | | 223.00 | 3,503.33 | | 0 | 17,477 | |
| 02260 | Excavation Support/Protection | | | | | | | | | | | | | | | | | | | |
| | Cofferdams | | | | | | | | | | | | | | | | | | | |
| 2 | Solid Beams & Lagging Piles 3" Wc | 1 | SF | 224.01 | B2a | 2.115 | 1 | 0.0 | 81.94 | 103.99 | 26.50 | 15.90 | | | 24.20 | 14.52 | | 0 | 134 | Water Diversion Dam For Constr. |
| 2 | Stop Log | | | | | | | | | | | | | | | | | | | |
| 2 | 8' x 8' Alum. Frame & Logs | 4 | EA | 38,727.01 | D1 | 96.000 | 384 | 8.0 | 76.39 | 29,332.35 | 30,000.00 | 120,000.00 | | | 14.52 | 5,575.68 | | 0 | 154,908 | |
| 2 | Trashrack Steel | 483 | LB | 23.83 | E4 | 0.024 | 12 | 0.4 | 84.84 | 987.40 | 21.79 | 10,523.36 | 5a | 1 | 0.04 | 0.46 | | 0 | 11,511 | |
| | Treated Wood | | | | | | | | | | | | | | | | | | | |
| 2 | Wood 6" x 8" x 8'-6" | 22,080 | BF | 10.77 | D1b | 0.082 | 1,808 | 64.6 | 73.27 | 132,492.01 | 4.41 | 97,372.80 | | | 0.36 | 8,037.12 | | 0 | 237,902 | |
| | Anchor Bolts | | | | | | | | | | | | | | | | | | | |
| 6 | Drill Anchor Bolt Holes | 494 | LF | 26 | A3 | 0.245 | 121 | 5.0 | 58.08 | 7,025.71 | 0.00 | 0.00 | | | 11.50 | 5,685.60 | | 0 | 12,711 | |
| 6 | Install Anchor Bolts | 480 | LF | 23 | A3 | 0.130 | 62 | 2.6 | 58.08 | 3,624.38 | 15.00 | 7,200.00 | | | | 0.00 | | 0 | 10,824 | |
| 02300 | Earthwork | | | | | | | | | | | | | | | | | | | |
| 02305 | Equipment Mobilization Or Demobilization | | | | | | | | | | | | | | | | | | | |
| 1 | Dump Truck (26 Tons) | 10 | EA | 544 | C1 | 2.000 | 20 | 2.5 | 71.88 | 1,437.54 | 0.00 | 0.00 | 3e1 | 2 | 25.23 | 504.50 | | 3,496 | 5,438 | Other: Driving Cost for 140Miles |
| 1 | Tractor Loader, Wheel, 1.5 to 1.75 | 2 | EA | 1,095 | C1 | 2.667 | 5 | 0.7 | 71.88 | 383.39 | 0.00 | 0.00 | 3g | 2 | 74.70 | 398.45 | | 1,407 | 2,189 | Other: Driving Cost for 140Miles |
| 1 | Dozers (Above 150 HP) | 3 | EA | 1,095 | C1 | 2.667 | 8 | 1.0 | 71.88 | 575.09 | 0.00 | 0.00 | 3g | 2 | 74.70 | 597.67 | | 2,111 | 3,284 | Other: Driving Cost for 140Miles |
| 1 | Crawler Type Drill, 4" | 1 | EA | 600 | C2 | 6.000 | 6 | 0.8 | 62.90 | 377.42 | 0.00 | 0.00 | 3h | 2 | 30.40 | 182.40 | | 40 | 600 | Other: Driving Cost for 140Miles |
| 1 | Air Compressor., 600 CFM | 1 | EA | 818 | C2 | 8.182 | 8 | 1.0 | 62.90 | 514.67 | 0.00 | 0.00 | 3h | 2 | 30.40 | 248.73 | | 55 | 818 | Included Drilling Machine |
| 1 | 50 Ft Air Hose, 3" Dia. | 1 | EA | 0 | C2 | 0.000 | 0 | 0.0 | 62.90 | 0.00 | 0.00 | 0.00 | 3h | 2 | 30.40 | 0.00 | | 0 | 0 | Included Drilling Machine |
| 1 | Excavator, 1 - 1.5 CY Diesel Hydra | 2 | EA | 4,378 | C1 | 10.667 | 21 | 2.7 | 71.88 | 1,533.42 | 0.00 | 0.00 | 3g | 2 | 74.70 | 1,593.65 | | 5,629 | 8,756 | Other: Driving Cost for 140Miles |
| 1 | 1 CY, 80 Ton Hydraulic Truck Mour | 1 | EA | 4,378 | C1 | 10.667 | 11 | 1.3 | 71.88 | 766.71 | 0.00 | 0.00 | 3g | 2 | 74.70 | 796.82 | | 2,814 | 4,378 | Other: Driving Cost for 140Miles |



BLACK & VEATCH

**PG&E**

Project: Yellow Creek Water Pipe Line Open Trenching
Project No. 136962.0144
Revision No.: 7
Date: 02/10/05

## Opinion Of Probable Cost

### Pipeline Trenching

| CSI Div. / Sect. | DESCRIPTION | Quantity | Unit | Unit Cost | Labor: Crew Code | Labor: M-H per Unit | Labor: Man Hours | Labor: Duration Days | Labor: Average Wage Rate | Labor: Labor Cost | Material: Unit Cost | Material: Material Cost | Equipment: Code | Equipment: No. | Equipment: Avg. Cost ($/hr) | Equipment: Equipment Cost | Sub-contract | Other | Total Cost | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Attachment Concrete Bucket, 2 CY | 1 | EA | 1,642 | C1 | 4.000 | 4 | 0.5 | 71.88 | 287.51 | 0.00 | 0.00 | 3g | 2 | 74.70 | 298.80 | | 1,055 | 1,642 | Other: Driving Cost for 140Miles |
| | 1 25 Ton Truck Mounted Hydraulic Cr | 2 | EA | 912 | C1 | 2.222 | 4 | 0.6 | 71.88 | 319.42 | 0.00 | 0.00 | 3g | 2 | 74.70 | 331.97 | | 1,172 | 1,824 | Other: Driving Cost for 140Miles |
| | 1 Concrete Batch Plant, Portable, 20 | 1 | EA | 6,567 | C1 | 16.000 | 16 | 2.0 | 71.88 | 1,150.03 | 0.00 | 0.00 | 3g | 2 | 74.70 | 1,195.20 | | 4,221 | 6,567 | Other: Driving Cost for 140Miles |
| | 1 Concrete Transit Mixer Truck | 4 | EA | 1,095 | C1 | 2.667 | 11 | 1.3 | 71.88 | 766.78 | 0.00 | 0.00 | 3g | 2 | 74.70 | 796.90 | | 2,815 | 4,378 | Other: Driving Cost for 140Miles |
| | 1 Grader 30,000 Lbs. | 2 | EA | 1,095 | C1 | 2.667 | 5 | 0.7 | 71.88 | 383.39 | 0.00 | 0.00 | 3g | 2 | 74.70 | 398.45 | | 1,407 | 2,189 | Other: Driving Cost for 140Miles |
| | 1 Water Truck (6,000 Gal.) | 2 | EA | 544 | C1 | 2.000 | 4 | 0.5 | 71.88 | 287.51 | 0.00 | 0.00 | 3e1 | 2 | 25.23 | 100.90 | | 699 | 1,088 | Other: Driving Cost for 140Miles |
| | 1 Grout Pumper | 1 | EA | 544 | C1 | 2.000 | 2 | 0.3 | 71.88 | 143.75 | 0.00 | 0.00 | 3e1 | 2 | 25.23 | 50.45 | | 350 | 544 | Other: Driving Cost for 140Miles |
| | 1 Wash & Screen | 1 | EA | 6,567 | C1 | 16.000 | 16 | 2.0 | 71.88 | 1,150.03 | 0.00 | 0.00 | 3g | 2 | 74.70 | 1,195.20 | | 4,221 | 6,567 | Other: Driving Cost for 140Miles |
| 02310 | **Grading** | 0 | LS | 0 | A1 | 0.000 | 0 | 0.0 | 58.08 | 0.00 | 0.00 | 0.00 | 1 | 1 | 69.81 | 0.00 | | 0 | 0 | |
| | **Finish Grading** | | | | | | | | | | | | | | | | | | | 50,260 |
| 02315 | **Excavation & Fill** | | | | | | | | | | | | | | | | | | | |
| | **Drilling & Blasting Rock** | | | | | | | | | | | | | | | | | | | |
| | 2 Drilling & Blasting | 578 | CY | 116.54 | B6 | 0.923 | 533 | 22.2 | 87.22 | 46,500.57 | 5.50 | 3,176.80 | 6h | 4 | 33.08 | 17,638.30 | | 0 | 67,316 | |
| | 3 Drilling & Blasting | 22 | CY | 116.54 | B6 | 0.923 | 21 | 0.9 | 87.22 | 1,803.35 | 5.50 | 123.20 | 6h | 4 | 33.08 | 684.03 | | 0 | 2,611 | |
| | 4 Drilling & Blasting | 1,733 | CY | 116.54 | B6 | 0.923 | 1,599 | 66.6 | 87.22 | 139,501.70 | 5.50 | 9,530.40 | 6h | 4 | 33.08 | 52,914.91 | | 0 | 201,947 | |
| | 5 Drilling & Blasting | 9,586 | CY | 116.54 | B6 | 0.923 | 8,848 | 368.6 | 87.22 | 771,703.31 | 5.50 | 52,720.80 | 6h | 4 | 33.08 | 292,717.68 | | 0 | 1,117,142 | |
| | 6 Drilling & Blasting | 158 | CY | 116.54 | B6 | 0.923 | 146 | 6.1 | 87.22 | 12,752.23 | 5.50 | 871.20 | 6h | 4 | 33.08 | 4,837.10 | | 0 | 18,461 | |
| | **Ripping** | | | | | | | | | | | | | | | | | | | |
| | 4 Rip Rap | 585 | CY | 30.00 | B2 | 0.258 | 151 | 18.9 | 81.63 | 12,320.94 | 4.00 | 2,340.00 | 4b | 0 | 19.12 | 2,886.16 | | 0 | 17,547 | |
| | 4 Hauling (10 Miles) | 585 | CY | 3.88 | C1 | 0.040 | 23 | 2.9 | 71.88 | 1,681.92 | 0.00 | 0.00 | 3e | 2 | 25.23 | 590.27 | | 0 | 2,272 | |
| | 5 Concrete Batch Plant & Delivery | 5,369 | CY | 128.55 | C6a | 0.480 | 2,577 | 40.3 | 71.09 | 183,197.47 | 76.50 | 410,728.50 | 8h1 | 6 | 37.35 | 96,252.79 | | 0 | 690,179 | |
| >>>> | 5 Grouting Rip Rap | 5,369 | CY | 48.18 | C17a | 0.690 | 3,705 | 77.2 | 65.16 | 241,382.51 | 0.00 | 0.00 | | | 3.22 | 17,288.18 | | 0 | 258,671 | |
| | **Hauling** | | | | | | | | | | | | | | | | | | | |
| | **Highway** | | | | | | | | | | | | | | | | | | | |
| | **16 Ton (12 CY) Dump Truck** | | | | | | | | | | | | | | | | | | | |
| | 20 Mile Round Trip 0.4 Loads/Hr. | 49,410 | CY | 35.04 | C1 | 0.267 | 13,168 | 1,646.0 | 71.88 | 946,459.44 | 0.00 | 0.00 | 3d1 | 1 | 59.62 | 785,018.26 | | 0 | 1,731,478 | 35% Swell Factor |
| >>>> | **Excavation, Trenching** | | | | | | | | | | | | | | | | | | | |
| | **Common Earth** | | | | | | | | | | | | | | | | | | | |
| | **6' To10' Deep** | | | | | | | | | | | | | | | | | | | |
| | 2 1 CY Truck Mounted Hydr. Excavat | 18 | CY | 6.91 | B5b | 0.052 | 1 | 0.1 | 72.28 | 67.65 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 56.78 | | 0 | 124 | |
| | 5 1 CY Truck Mounted Hydr. Excavat | 9,752 | CY | 6.91 | B5b | 0.052 | 507 | 31.7 | 72.28 | 36,651.45 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 30,764.31 | | 0 | 67,416 | |
| | 6 1 CY Truck Mounted Hydr. Excavat | 63 | CY | 6.91 | B5b | 0.052 | 3 | 0.2 | 72.28 | 236.78 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 198.74 | | 0 | 436 | |
| | **Rock (Hydraulic Jackhammer)** | | | | | | | | | | | | | | | | | | | |
| | **6' To10' Deep** | | | | | | | | | | | | | | | | | | | |
| | 2 1 CY Truck Mounted Hydr. Excavat | 144 | CY | 12.27 | B5b | 0.092 | 13 | 0.8 | 72.28 | 963.30 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 808.57 | | 0 | 1,772 | |
| | 3 1 CY Truck Mounted Hydr. Excavat | 6 | CY | 12.27 | B5b | 0.092 | 1 | 0.0 | 72.28 | 37.36 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 31.36 | | 0 | 69 | |
| | 4 1 CY Truck Mounted Hydr. Excavat | 433 | CY | 12.27 | B5b | 0.092 | 40 | 2.5 | 72.28 | 2,889.91 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 2,425.72 | | 0 | 5,316 | |
| | 5 1 CY Truck Mounted Hydr. Excavat | 2,396 | CY | 12.27 | B5b | 0.092 | 221 | 13.8 | 72.28 | 15,986.56 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 13,418.72 | | 0 | 29,405 | |
| | 6 1 CY Truck Mounted Hydr. Excavat | 40 | CY | 12.27 | B5b | 0.092 | 4 | 0.2 | 72.28 | 264.17 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 221.74 | | 0 | 486 | |
| | **Rock (Drill & Blasted Materials)** | | | | | | | | | | | | | | | | | | | |
| | **6' To10' Deep** | | | | | | | | | | | | | | | | | | | |
| | 2 1 CY Truck Mounted Hydr. Excavat | 578 | CY | 8.99 | B5b | 0.068 | 39 | 2.4 | 72.28 | 2,822.07 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 2,368.78 | | 0 | 5,191 | |
| | 3 1 CY Truck Mounted Hydr. Excavat | 22 | CY | 8.99 | B5b | 0.068 | 2 | 0.1 | 72.28 | 109.44 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 91.86 | | 0 | 201 | |
| | 4 1 CY Truck Mounted Hydr. Excavat | 1,733 | CY | 8.99 | B5b | 0.068 | 117 | 7.3 | 72.28 | 8,466.21 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 7,106.33 | | 0 | 15,573 | |
| | 5 1 CY Truck Mounted Hydr. Excavat | 9,586 | CY | 8.99 | B5b | 0.068 | 648 | 40.5 | 72.28 | 46,833.88 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 39,311.18 | | 0 | 86,145 | |
| | 6 1 CY Truck Mounted Hydr. Excavat | 158 | CY | 8.99 | B5b | 0.068 | 11 | 0.7 | 72.28 | 773.92 | 0.00 | 0.00 | 1e1 | 1 | 60.67 | 649.61 | | 0 | 1,424 | |
| | **2-1/2 CY Bucket Wheel Mtd. Front End Loader** | | | | | | | | | | | | | | | | | | | |
| | 2 Minimal Haul | 532 | CY | 13.13 | B5 | 0.052 | 28 | 2.3 | 75.12 | 2,078.11 | 7.90 | 4,202.80 | 2e3 | 1 | 25.44 | 703.90 | | 0 | 6,985 | |
| | 4 Minimal Haul | 983 | CY | 13.13 | B5 | 0.052 | 51 | 4.3 | 75.12 | 3,839.82 | 7.90 | 7,765.70 | 2e3 | 1 | 25.44 | 1,300.62 | | 0 | 12,906 | |
| | 5 Minimal Haul | 8,477 | CY | 13.13 | B5 | 0.052 | 441 | 36.7 | 75.12 | 33,113.05 | 7.90 | 66,968.30 | 2e3 | 1 | 25.44 | 11,216.01 | | 0 | 111,297 | |
| | 6 Minimal Haul | 183 | CY | 13.13 | B5 | 0.052 | 10 | 0.8 | 75.12 | 714.84 | 7.90 | 1,445.70 | 2e3 | 1 | 25.44 | 242.13 | | 0 | 2,403 | |
| >>>> | **Excavation, Utility Trenching** | | | | | | | | | | | | | | | | | | | |
| | **Utility Bedding** | | | | | | | | | | | | | | | | | | | |
| | 4 Crushed Stone 3/4" To 1/2' | 114 | CY | 42.99 | B4b | 0.208 | 24 | 0.7 | 67.70 | 1,605.34 | 27.50 | 3,135.00 | 2a | 1 | 6.76 | 160.40 | | 0 | 4,901 | |
| | 5 Crushed Stone 3/4" To 1/2' | 1,369 | CY | 42.99 | B4b | 0.208 | 285 | 8.9 | 67.70 | 19,278.21 | 27.50 | 37,647.50 | 2a | 1 | 6.76 | 1,926.23 | | 0 | 58,852 | |
| | 6 Crushed Stone 3/4" To 1/2' | 13 | CY | 42.99 | B4b | 0.208 | 3 | 0.1 | 67.70 | 183.07 | 27.50 | 357.50 | 2a | 1 | 6.76 | 18.29 | | 0 | 559 | |
| 02370 | **Erosion & Sedimentation Control** | | | | | | | | | | | | | | | | | | | |
| | **Rip-Rap & Rock Lining** | | | | | | | | | | | | | | | | | | | |
| | **Synthetic Erosion Control** | | | | | | | | | | | | | | | | | | | |
| | 2 Silt Fence | 920 | LF | 4.61 | C2a | 0.068 | 63 | 2.0 | 61.70 | 3,859.81 | 0.42 | 382.72 | | | | 0.00 | | 0 | 4,243 | |
| | 3 Silt Fence | 112 | LF | 4.61 | C2a | 0.068 | 8 | 0.2 | 61.70 | 469.89 | 0.42 | 46.59 | | | | 0.00 | | 0 | 516 | |
| | 4 Silt Fence | 1,235 | LF | 4.61 | C2a | 0.068 | 84 | 2.6 | 61.70 | 5,181.38 | 0.42 | 513.76 | | | | 0.00 | | 0 | 5,695 | |



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PG&E

Project: Yellow Creek Water Pipe Line Open Trenching
Project No. 136962.0144
Revision No.: 7
Date: 02/10/05

## Opinion Of Probable Cost

Pipeline Trenching

| CSI Div. / Sect. | DESCRIPTION | Quantity | Unit | Unit Cost | Labor: Crew Code | Labor: M-H per Unit | Labor: Man Hours | Labor: Duration Days | Labor: Average Wage Rate | Labor: Labor Cost | Material: Unit Cost | Material: Material Cost | Equipment: Code | Equipment: No. | Equipment: Avg. Cost ($/hr) | Equipment: Equipment Cost | Sub-contract | Other | Total Cost | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 Silt Fence | 14,594 | LF | 4.61 | C2a | 0.068 | 992 | 31.0 | 61.70 | 61,228.35 | 0.42 | 6,071.10 | | | | 0.00 | | 0 | 67,299 | |
| | 6 Silt Fence | 56 | LF | 4.61 | C2a | 0.068 | 4 | 0.1 | 61.70 | 234.95 | 0.42 | 23.30 | | | | 0.00 | | 0 | 258 | |
| 02510 | Water Distribution | | | | | | | | | | | | | | | | | | | |
| | Water Supply | | | | | | | | | | | | | | | | | | | |
| | Concrete Pipe | | | | | | | | | | | | | | | | | | | |
| | 4 36" Dia. | 1,235 | LF | 140.02 | B5d | 0.641 | 792 | 14.1 | 69.11 | 54,738.55 | 86.35 | 106,642.25 | | | 9.35 | 11,547.25 | | 0 | 172,928 | |
| | 5 36" Dia. | 14,578 | LF | 140.02 | B5d | 0.641 | 9,349 | 166.9 | 69.11 | 646,136.56 | 86.35 | 1,258,810.30 | | | 9.35 | 136,304.30 | | 0 | 2,041,251 | |
| | 6 36" Dia. | 139 | LF | 140.02 | B5d | 0.641 | 89 | 1.6 | 69.11 | 6,160.86 | 86.35 | 12,002.65 | | | 9.35 | 1,299.65 | | 0 | 19,463 | |
| | Black Steel Pipe | | | | | | | | | | | | | | | | | | | |
| | 6 36" Dia. 1/2" Wall Thickness w/ Co | 155 | LF | 544.55 | B5d | 3.413 | 529 | 9.4 | 69.11 | 36,556.91 | 260.70 | 40,408.50 | | | 48.00 | 7,440.00 | | 0 | 84,405 | |
| | Copper Pipe | | | | | | | | | | | | | | | | | | | |
| 02600 | Drainage & Containment | | | | | | | | | | | | | | | | | | | |
| 02630 | Strom Drainage | | | | | | | | | | | | | | | | | | | |
| | Strom Drainage Piping | | | | | | | | | | | | | | | | | | | |
| | Corrugated Metal | | | | | | | | | | | | | | | | | | | |
| | 2 24" Dia. 14 Ga. Galvanized | 20 | LF | 99.92 | B5d | 0.356 | 7 | 0.1 | 69.11 | 492.37 | 27.30 | 546.00 | | | 48.00 | 960.00 | | 0 | 1,998 | |
| 02840 | Walk/Road/Parking Appurtenances | | | | | | | | | | | | | | | | | | | |
| | Guide/Guard Rail | | | | | | | | | | | | | | | | | | | |
| | 5 Guider (Steel) | 14,706 | LF | 27.44 | B4c | 0.064 | 947 | 29.6 | 67.70 | 64,118.05 | 22.00 | 323,532.00 | | | 1.08 | 15,897.19 | | 0 | 403,547 | |
| | 6 Guider (Steel) | 83 | LF | 27.44 | B4c | 0.064 | 5 | 0.2 | 67.70 | 361.88 | 22.00 | 1,826.00 | | | 1.08 | 89.72 | | 0 | 2,278 | |
| 02850 | Prefabricated Bridges | | | | | | | | | | | | | | | | | | | |
| | Concrete Inplace | | | | | | | | | | | | | | | | | | | |
| | 3 Abutment | 24 | CY | 810.64 | A10k | 10.339 | 245 | 3.1 | 58.84 | 14,420.11 | 170.10 | 4,032.00 | | | 32.19 | 763.02 | | 0 | 19,215 | Vehicular Bridge Construction |
| | 5 Abutment | 15 | CY | 810.64 | A10k | 10.339 | 159 | 2.0 | 58.84 | 9,373.07 | 170.10 | 2,620.80 | | | 32.19 | 495.96 | | 0 | 12,490 | Vehicular Bridge Construction |
| | 3 Abutment Parapets | 44 | CY | 1,457.87 | A10k | 19.816 | 881 | 11.0 | 58.84 | 51,822.90 | 229.50 | 10,200.00 | | | 62.35 | 2,771.11 | | 0 | 64,794 | Vehicular Bridge Construction |
| | 3 Pier Footing | 4 | CY | 538.48 | A10k | 5.945 | 21 | 0.3 | 58.84 | 1,243.81 | 170.10 | 604.80 | | | 18.56 | 65.99 | | 0 | 1,915 | Vehicular Bridge Construction |
| | 5 Pier Footing | 2 | CY | 538.48 | A10k | 5.945 | 11 | 0.1 | 58.84 | 621.91 | 170.10 | 302.40 | | | 18.56 | 33.00 | | 0 | 957 | Vehicular Bridge Construction |
| | 3 Piers & Columns | 7 | CY | 2,511.74 | A10k | 32.750 | 243 | 3.0 | 58.84 | 14,274.75 | 465.75 | 3,450.00 | | | 118.90 | 880.74 | | 0 | 18,605 | Vehicular Bridge Construction |
| | 5 Piers & Columns | 1 | CY | 2,511.74 | A10k | 32.750 | 24 | 0.3 | 58.84 | 1,427.47 | 465.75 | 345.00 | | | 118.90 | 88.07 | | 0 | 1,861 | Vehicular Bridge Construction |
| | 3 Pier Caps | 4 | CY | 1,754.04 | A10k | 23.780 | 85 | 1.1 | 58.84 | 4,975.24 | 280.80 | 998.40 | | | 73.95 | 262.93 | | 0 | 6,237 | Vehicular Bridge Construction |
| | 5 Pier Caps | 1 | CY | 1,754.04 | A10k | 23.780 | 18 | 0.2 | 58.84 | 1,036.51 | 280.80 | 208.00 | | | 73.95 | 54.78 | | 0 | 1,299 | Vehicular Bridge Construction |
| | 3 Deck 8" Thick | 1,800 | SF | 27.22 | A10k | 0.336 | 605 | 7.6 | 58.84 | 35,588.25 | 6.05 | 10,886.40 | | | 1.40 | 2,520.00 | | 0 | 48,995 | Vehicular Bridge Construction |
| | Prestressed Concrete Precasted | | | | | | | | | | | | | | | | | | | |
| | 3 Box Girders 50' Span | 3 | EA | 21,000.00 | A10k | 0.000 | 0 | 0.0 | 58.84 | 0.00 | 0.00 | 0.00 | | | 0.00 | 0.00 | 63,000 | | 63,000 | Vehicular Bridge Construction |
| | 3 I Beams 60' Span | 6 | EA | 12,285.00 | A10k | 0.000 | 0 | 0.0 | 58.84 | 0.00 | 0.00 | 0.00 | | | 0.00 | 0.00 | | 73,710 | 73,710 | Misc. Structures |
| 02890 | Traffic Signs & Signals | | | | | | | | | | | | | | | | | | | 313,077 |
| | Signs | | | | | | | | | | | | | | | | | | | |
| | 5 Signage | 1 | LS | 25,806.24 | A4 | 280.000 | 280 | 8.8 | 58.08 | 16,263.24 | 7,500.00 | 7,500.00 | | | 2,000.00 | 2,000.00 | | 43 | 25,806 | |
| | Traffic Signals | | | | | | | | | | | | | | | | | | | |
| | 5 2 Signals | 1 | LS | 339,817.59 | A4 | 3,730 | 3,730 | 116.6 | 58.08 | 216,649.59 | 121,000.00 | 121,000.00 | | | 2,125.00 | 2,125.00 | | 43 | 339,818 | |
| 02950 | Site Restoration & Rehab | | | | | | | | | | | | | | | | | | | |
| | 2 Clean-Up & Repairs | 0.07 | LS | 249,935.78 | A4 | 2,925 | 219 | 6.9 | 58.08 | 12,736.98 | 50,000.00 | 3,748.54 | | | 30,000.00 | 2,249.12 | | 3 | 18,738 | |
| | 3 Clean-Up & Repairs | 0.22 | LS | 249,935.78 | A4 | 2,925 | 651 | 20.4 | 58.08 | 37,833.15 | 50,000.00 | 11,134.42 | | | 30,000.00 | 6,680.65 | | 10 | 55,658 | |
| | 4 Clean-Up & Repairs | 0.02 | LS | 249,935.78 | A4 | 2,925 | 69 | 2.2 | 58.08 | 4,009.13 | 50,000.00 | 1,179.90 | | | 30,000.00 | 707.94 | | 1 | 5,898 | |
| | 5 Clean-Up & Repairs | 0.64 | LS | 623,725.16 | A4 | 2,925 | 1,878 | 58.7 | 58.08 | 109,083.53 | 50,000.00 | 32,103.64 | | | 30,000.00 | 19,262.18 | 240,000 | 28 | 400,477 | |
| | 6 Clean-Up & Repairs | 0.04 | LS | 249,935.78 | A4 | 2,925 | 107 | 3.4 | 58.08 | 6,229.88 | 50,000.00 | 1,833.48 | | | 30,000.00 | 1,100.09 | | 2 | 9,165 | |
| 02965 | Flex./Bit. Pavement Recycling | | | | | | | | | | | | | | | | | | | |
| | Cold In-Place Recycled Bituminous Pavement Courses | | | | | | | | | | | | | | | | | | | |
| | Hot In-Place Recycled Bituminous Pavement Courses | | | | | | | | | | | | | | | | | | | |
| | 5 Spot Repairs | 44 | SY | 13.06 | B5c | 0.048 | 2 | 0.0 | 71.34 | 150.66 | 3.41 | 150.04 | | | 6.23 | 273.90 | | 0 | 575 | |
| | Subtotal Site Construction | | | | | | 69,973 | | | 4,863,652 | | 2,811,210 | | | | 1,761,222 | 240,000 | 168,333 | 9,844,417 | |
| 3 | Concrete | | | | | | | | | | | | | | | | | | | |
| 03310 | Structural concrete | | | | | | | | | | | | | | | | | | | |
| | 2 Placing Conc Slabs | 4 | CY | 443.37 | D7a | 4.965 | 18 | 0.2 | 65.95 | 1,164.31 | 115.00 | 408.89 | 8e1 | 1 | 0.18 | 3.24 | | 0 | 1,576 | Dirct Chute |
| | 4 Placing Conc Slabs | 4 | CY | 443.37 | D7a | 4.965 | 20 | 0.2 | 65.95 | 1,309.85 | 115.00 | 460.00 | 8e1 | 1 | 0.18 | 3.65 | | 0 | 1,773 | Dirct Chute |



BLACK & VEATCH

**PG&E**

**Project:** Yellow Creek Water Pipe Line Open Trenching
**Project No.** 136962.0144
**Revision No.:** 7
**Date:** 02/10/05

## Opinion Of Probable Cost

### Pipeline Trenching

| CSI Div. / Sect. | DESCRIPTION | Quantity | Unit | Unit Cost | Labor: Crew Code | Labor: M-H per Unit | Labor: Man Hours | Labor: Duration Days | Labor: Average Wage Rate | Labor: Labor Cost | Material: Unit Cost | Material: Material Cost | Equipment: Code | Equipment: No. | Equipment: Avg. Cost ($/hr) | Equipment: Equipment Cost | Sub-contract | Other | Total Cost | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 Placing Conc Slabs | 24 | CY | 443.37 | D7a | 4.965 | 119 | 1.1 | 65.95 | 7,859.07 | 115.00 | 2,760.00 | 8e1 | 1 | 0.18 | 21.90 | | 0 | 10,641 | Dirct Chute |
| | 2 Placing Conc Foundation | 59 | CY | 524.85 | D7b | 6.455 | 384 | 2.7 | 57.25 | 21,966.37 | 115.00 | 6,836.11 | 8g1 | 4 | 6.25 | 2,397.09 | | 0 | 31,200 | Crane w/ Conc Bucket |
| | 5 Placing Conc Foundation | 43 | CY | 524.85 | D7b | 6.455 | 278 | 1.9 | 57.25 | 15,889.69 | 115.00 | 4,945.00 | 8g1 | 4 | 6.25 | 1,733.97 | | 0 | 22,569 | Crane w/ Conc Bucket |
| | 2 Placing Conc Walls | 109 | CY | 966.88 | D7b | 13.306 | 1,448 | 10.1 | 57.25 | 82,918.49 | 122.00 | 13,279.93 | 8g1 | 4 | 6.25 | 9,048.53 | | 0 | 105,247 | Crane w/ Conc Bucket |
| | 2 Concrete Batch Plant & Delivery | 172 | CY | 52.05 | C6a | 0.480 | 82 | 1.3 | 71.09 | 5,863.82 | 0.00 | 0.00 | 8h1 | 6 | 37.35 | 3,080.88 | | 0 | 8,945 | |
| | 4 Concrete Batch Plant & Delivery | 4 | CY | 52.05 | C6a | 0.480 | 2 | 0.0 | 71.09 | 136.49 | 0.00 | 0.00 | 8h1 | 6 | 37.35 | 71.71 | | 0 | 208 | |
| | 5 Concrete Batch Plant & Delivery | 110 | CY | 52.05 | C6a | 0.480 | 53 | 0.8 | 71.09 | 3,753.35 | 0.00 | 0.00 | 8h1 | 6 | 37.35 | 1,972.03 | | 0 | 5,725 | |
| 03370 | Specially Placed Concrete | | | | | | | | | | | | | | | | | | | |
| | 5 Box Culverts & Transtions | 43 | CY | 935.26 | D7b | 12.272 | 528 | 3.7 | 57.25 | 30,211.21 | 156.00 | 6,708.00 | 8g1 | 4 | 6.25 | 3,296.82 | | 0 | 40,216 | Crane w/ Conc Bucket |
| | Subtotal Concrete | 0 | LS | 0 | A1 | 0.000 | 0 | 0.0 | 58.08 | 0.00 | 0.00 | 0.00 | 1 | 1 | 69.81 | 0.00 | | 0 | 0 | |
| | | | | | | | 2,931 | | | 171,073 | | 35,398 | | | | 21,630 | 0 | 0 | 228,100 | |
| 5 | Metals | | | | | | | | | | | | | | | | | | | |
| 05100 | Structural Metal Framing | | | | | | | | | | | | | | | | | | | |
| | 2 Structural Steel | 11 | Tons | 7,658.22 | E4 | 55.424 | 621 | 19.4 | 84.84 | 52,661.46 | 2,075.00 | 23,240.00 | 5a | 1 | 15.90 | 9,870.64 | | 0 | 85,772 | |
| | Stair Tower | | | | | | | | | | | | | | | | | | | |
| | 6 Structural Steel | 6 | Tons | 7,658.22 | E4 | 55.424 | 316 | 9.9 | 84.84 | 26,800.92 | 2,075.00 | 11,827.50 | 5a | 1 | 15.90 | 5,023.45 | | 0 | 43,652 | |
| | Pipe Bridge | | | | | | | | | | | | | | | | | | | |
| | 5 Structural Steel | 12 | Tons | 2,880.00 | E4 | 9.639 | 112 | 3.5 | 84.84 | 9,485.60 | 1,909.00 | 22,144.40 | 5a | 1 | 15.90 | 1,777.94 | | 0 | 33,408 | |
| | 5 Structural Steel - Pie Supports | 3 | Tons | 3,863.09 | E4 | 13.013 | 41 | 1.3 | 84.84 | 3,477.37 | 2,552.25 | 8,039.59 | 5a | 1 | 15.90 | 651.78 | | 0 | 12,169 | |
| | 6 Steel - Anchor Rings | 5 | EA | 730.94 | E4 | 4.000 | 20 | 0.6 | 84.84 | 1,696.70 | 328.00 | 1,640.00 | 5a | 1 | 15.90 | 318.02 | | 0 | 3,655 | |
| 05500 | Metal Fabrications | | | | | | | | | | | | | | | | | | | |
| | Stair Tower | | | | | | | | | | | | | | | | | | | |
| | 6 Floor Grating w/ Framing | 176 | SF | 81.18 | E4 | 0.653 | 115 | 3.6 | 84.84 | 9,742.45 | 15.45 | 2,719.20 | 5a | 1 | 15.90 | 1,826.08 | | 0 | 14,288 | |
| | 6 Custom Steel Stairs, 3' Wide | 160 | Riser | 545.46 | E4 | 3.201 | 512 | 16.0 | 84.84 | 43,449.09 | 223.00 | 35,680.00 | 5a | 1 | 15.90 | 8,143.91 | | 0 | 87,273 | |
| | 6 Hand Railing, 1.5" Dia., Galv. | 755 | LF | 76.64 | E4 | 0.600 | 453 | 14.2 | 84.84 | 38,430.26 | 16.20 | 12,231.00 | 5a | 1 | 15.90 | 7,203.20 | | 0 | 57,864 | |
| | Subtotal Metals | 0 | LS | 0 | A1 | 0.000 | 0 | 0.0 | 58.08 | 0.00 | 0.00 | 0.00 | 1 | 1 | 69.81 | 0.00 | | 0 | 0 | |
| | | | | | | | 2,189 | | | 185,744 | | 117,522 | | | | 34,815 | 0 | 0 | 338,081 | |
| | **Construction Subtotal (Direct Costs)** | | | | | | 75,094 | | | 5,220,469 | | 2,964,130 | | | | 1,817,667 | 240,000 | 1,599,790 | **11,842,055** | |

| | | | |
|---|---|---|---|
| **Indirect Costs** | | | |
| Sales Tax | 8% | of purchased materials + Rental Equipment | 382,544 |
| Ocean Shipping | 0% | of purchased off-shore materials | 0 |
| Ocean Shipping | 0% | of purchased off-shore Rental Equipment | 0 |
| Overhead and Profit | 12% | of construction cost + general requirements | 1,421,047 |
| Bonds and Insurance | 4% | of construction cost + general requirements + sales tax + overhead and profit | 545,826 |
| Escalation (FY2010) | 9.15% | of construction cost | 1,298,520 |
| Contingency | 50% | of construction cost + general conditions + sales tax + overhead and profit + bonds and insurance + escalation | 7,744,995 |
| **Construction Subtotal Indirects** | | | **11,392,931** |
| **Total Construction (directs and Indirects)** | | | **23,234,986** |
| **Permits** | 10% | of construction cost | 2,323,499 |
| **Design** | 10% | of construction cost | 2,323,499 |
| **Construction Management** | 10% | of construction cost | 2,323,499 |
| **PG&E** | | | |
| Owner Administration and Overhead | 5.5% | of construction cost + permits + design + construction management | 1,661,302 |
| FCFFDC | 23.0% | of constr. cost + permits + design + constr. management +PG&E owner admin. & overhead | 7,329,360 |
| **Total** | | | **39,196,144** |



BLACK & VEATCH

# *Appendix C – Construction Quantities*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow Creek CW Pipeline** | | | | | | |
| Quantity details | | | | | | |
| | | | | | | |
| **Fishway** | | | | | | |
| **Sediment and erosion control** | | | | | **120 LF** | |
| | | | | | | |
| **Clearing (incl trees)** | area (sf) | slope factor | total area | | | |
| area | 105 | 1.4 | 147 | SF | **16 SY** | |
| | | | | | | |
| **Excavation** | area/lf (sf) | length (ft) | volume | | | |
| | 45 | 105 | 4725 | CF | | |
| | | | 175 | CY | | |
| | rock | 90% | | | **158 CY** | |
| | earth | 10% | | | **17 CY** | |
| | | | | | | |
| | | | | | | |
| **Concrete** | number | length (ft) | width/depth (ft) | thickness (ft) | volume | |
| side walls | 2 | 103 | 8 | 1 | 1648 | CF |
| cross walls | 11 | 6 | 6 | 1 | 396 | CF |
| base | 1 | 105 | 10 | 1 | 1050 | CF |
| | | | | | 3094 | CF |
| | | | | | **115 CY** | |
| | | | | | | |
| **Dam** | | | | | | |
| **Sediment and erosion control** | | | | | | |
| | | | | | **60 LF** | |
| | | | | | | |
| **Clearing (incl trees)** | area (sf) | slope factor | total area | | | |
| area | 240 | 1.1 | 264 | SF | **29 SY** | |
| | | | | | | |
| **Excavation** | length (ft) | width (ft) | depth (ft) | volume | | |
| | 60 | 8 | 2 | 480 | CF | |
| | | | | 18 | CY | |
| | rock | 95% | | | **17 CY** | |
| | earth | 5% | | | **1 CY** | |
| | | | | | | |
| **Concrete** | number | length (ft) | width/depth (ft) | thickness (ft) | volume | |
| step 1 | 1 | 12 | 6 | 2 | 144 | CF |
| step 2 | 1 | 9 | 6 | 2 | 108 | CF |
| step 3 | 1 | 8 | 6 | 2 | 96 | CF |
| step 4 | 1 | 9 | 6 | 2 | 108 | CF |
| intake base | 1 | 6 | 6 | 2 | 72 | CF |
| intake wall | 1 | 2 | 5 | 2 | 20 | CF |
| wall 1 | 2 | 8 | 2 | 1 | 32 | CF |
| wall 2 | 2 | 7 | 2 | 1 | 28 | CF |
| wall 3 | 1 | 3 | 2 | 1 | 6 | CF |
| top walk | 1 | 36 | 4 | 0.67 | 96 | CF |
| | | | | | 710 | CF |
| | | | | | **26 CY** | |
| | | | | | | |
| **Stop logs** | number | length (ft) | | | | |
| sills | 4 | 8.67 | | | **35 LF** | |
| end slot embeds | 8 | 7.5 | | | **60 LF** | |
| stop logs (6-inch) | 26 | 8.67 | | | **226 LF** | |
| | | | | | | |
| **36-inch slide gate** | | | | | **1 EA** | |
| | | | | | | |
| **Trashrack** | horizontal (ft) | vertical (ft) | width (ft) | bar thick (in) | bar depth (in) | clear (in) |
| | 2 | 4 | 4 | 0.5 | 3 | 2 |
| | number | length (ft) | weight (lb/bar) | weight | | |
| | 21 | 4.5 | 23.0 | 483 | LB | |
| | | | | | **0.2 TN** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow Creek CW Pipeline** | | | | | | |
| Quantity details | | | | | | |
| | | | | | | |
| **Bridge (over Yellow Creek)** | | | | | | |
| **Substructure** | | | | | | |
| **Sediment & erosion control** | | | | | | |
| piers | | | 48 | LF | | |
| abutments | | | 64 | LF | | |
| | | | | | **112** | **LF** |
| | | | | | | |
| **Clearing** | area (sf) | slope factor | total area | | | |
| abutments | 240 | 1.15 | 276 | SF | **31** | **SY** |
| | | | | | | |
| **Excavation** | number | length (ft) | width (ft) | depth (ft) | volume | |
| piers | 2 | 4 | 4 | 4 | 128 | CF |
| abutments | 2 | 20 | 4 | 4 | 640 | CF |
| | | | | | 768 | CF |
| | | | | | **28** | **CY** |
| | | | | | | |
| **Concrete** | | | | | | |
| pier footings | 2 | 4 | 4 | 3 | 96 | CF |
| piers | 2 | 25 | 2 | 2 | 200 | CF |
| pier caps | 2 | 12 | 2 | 2 | 96 | CF |
| abutments | 2 | 20 | 4 | 4 | 640 | CF |
| | | | | | 1032 | CF |
| | | | | | **38** | **CY** |
| | | | | | | |
| **Superstructure** | | | | | | |
| | | | | | | |
| | | | | | | |
| **Road** | | | | | | |
| **Sediment & erosion control** | | | | | **740** | **LF** |
| | | | | | | |
| **Clearing (incl trees)** | length (ft) | area (sf/ft) | area | | | |
| | 740 | 22 | 16280 | SF | **1809** | **SY** |
| | | | | | | |
| **Excavation** | | | | | | |
| road | length (ft) | volume (cf/ft) | volume | | | |
| | 740 | 18.86 | 13956 | CF | | |
| ret wall footings | length (ft) | spacing (ft) | number | volume (cf/ea) | volume | |
| | 740 | 8 | 93 | 8.7 | 809 | CF |
| | | | | | 14765 | CF |
| | | | | | **547** | **CY** |
| | | | | | | |
| **Concrete** | | | | | | |
| ret wall footings | | | | | 809 | CF |
| | | | | | **30** | **CY** |
| | | | | | | |
| **Steel (galvanized)** | number | length (ft) | weight (lb/ft) | weight | | |
| ret wall posts | 93 | 8 | 30 | 22320 | LB | |
| | | | | | **11.2** | **TN** |
| | | | | | | |
| **Wood (treated)** | spans | length (ft) | height (ft) | thickness (in) | volume | |
| ret wall | 92 | 8 | 5 | 6 | **22080** | **BF** |
| | | | | | | |
| **24-inch CMP** | | | | | **20** | **LF** |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| select fill | 740 | 19.40 | 14356 | CF | **532** | **CY** |
| gravel surf | 740 | 6.25 | 4625 | CF | **171** | **CY** |
| | | | | | | |
| | | | | | | |
| **Pipe - diversion dam to SR-70** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow Creek CW Pipeline** | | | | | | |
| Quantity details | | | | | | |
| | | | | | | |
| **Sediment & erosion control** | | | | | **1235** | **LF** |
| | | | | | | |
| **Clearing (incl trees)** | length (ft) | area (sf/ft) | area | | | |
| | 1235 | 11.45 | 14141 | SF | **1571** | **SY** |
| | | | | | | |
| **Excavation** | | | | | | |
| trench | length (ft) | volume (cf/ft) | volume | | | |
| | 1235 | 47.36 | 58490 | CF | **2166** | **CY** |
| | | | | | | |
| **Furnish & install pipe (does not include specials)** | | | | | | |
| 36-in reinf conc pipe | | | | | **1235** | **LF** |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| bedding | 1235 | 2.50 | 3088 | CF | **114** | **CY** |
| select fill | 1235 | 21.50 | 26553 | CF | **983** | **CY** |
| riprap (**not grouted**) | 1235 | 12.80 | 15808 | CF | **585** | **CY** |
| | | | | | | |
| | | | | | | |
| **Pipe - under SR-70** | | | | | | |
| | length (ft) | | | | | |
| | 66 | | | | | |
| **Traffic control** | | | | | **66** | **LF** |
| | | | | | | |
| **Sawcutting** | | | | | **132** | **LF** |
| | | | | | | |
| **Pavement removal** | length (ft) | width (ft) | | area | | |
| 8-in thick | 66 | 6 | | 396 | SF | |
| | | | | | **44** | **SY** |
| | | | | | | |
| **Excavation** | | | | | | |
| trench | length (ft) | volume (cf/ft) | volume | | | |
| rock | 66 | 28.33 | 1870 | CF | **69** | **CY** |
| earth | 66 | 5 | 330 | CF | **12** | **CY** |
| | | | | | | |
| **Furnish & install pipe (does not include specials)** | | | | | | |
| 36-in reinf conc pipe | | | | | **66** | **LF** |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| conc encasement | 66 | 17.77 | 1173 | CF | **43** | **CY** |
| select fill | 66 | 5.00 | 330 | CF | **12** | **CY** |
| | | | | | | |
| **Pavement replacement** | length (ft) | width (ft) | | area | | |
| 8-in thick | 66 | 6 | | 396 | SF | |
| | | | | | **44** | **SY** |
| | | | | | | |
| **Pipe - along SR-70 to Rock Creek Dam (except bridge at Chips Creek)** | | | | | | |
| | | | | | | |
| **Sediment & erosion control (does not include Chips Creek)** | | | | | **14520** | **LF** |
| | | | | | | |
| **Traffic control** | | | | | **14640** | **LF** |
| | | | | | | |
| **Clearing** | length (ft) | area (sf/ft) | area | | | |
| | 14640 | 6 | 87840 | SF | **9760** | **SY** |
| | | | | | | |
| **Guardrail removal & reinstallation** | | | | | **12940** | **LF** |
| | | | | | | |
| **Excavation** | length (ft) | area/lf (sf) | volume | | | |
| trench | 14640 | 39.5 | 578280 | CF | | |
| | | | 21418 | CY | | |
| | rock | 55% | | | **11780** | **CY** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow Creek CW Pipeline** | | | | | | |
| Quantity details | | | | | | |
| | | | | | | |
| | earth | 45% | | | **9638 CY** | |
| | | | | | | |
| **Furnish & install pipe (does not include specials)** | | | | | | |
| 36-in reinf conc pipe | | | | | **14392 LF** | |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| bedding | 14640 | 2.50 | 36600 | CF | **1356 CY** | |
| select fill | 14640 | 15.52 | 227213 | CF | **8415 CY** | |
| grouted riprap | 14640 | 9.83 | 143911 | CF | **5330 CY** | |
| shoulder repair | 14640 | 2.44 | 35722 | SF | **3969 SY** | |
| | | | | | | |
| | | | | | | |
| **Pipe - bridge at Chips Creek** | | | | | | |
| | | | | | | |
| **Sediment & erosion control (see Bridge over Chips Creek below)** | | | | | **0 LF** | |
| | | | | | | |
| **Traffic control (included in main run)** | | | | | **0 LF** | |
| | | | | | | |
| **Clearing** | length (ft) | area (sf/ft) | area | | | |
| | 12 | 6 | 72 | SF | **8 SY** | |
| | | | | | | |
| **Excavation** | length (ft) | area/lf (sf) | volume | | | |
| trench | 12 | 39.5 | 474 | CF | | |
| | | | 18 | CY | | |
| | rock | 55% | | | **10 CY** | |
| | earth | 45% | | | **8 CY** | |
| | | | | | | |
| **Furnish & install pipe** | | | | | | |
| 36-in reinf conc pipe | | | | | **120 LF** | |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| bedding | 12 | 2.50 | 30 | CF | **1 CY** | |
| select fill | 12 | 15.52 | 186 | CF | **7 CY** | |
| grouted riprap | 12 | 9.83 | 118 | CF | **4 CY** | |
| shoulder repair | 12 | 2.44 | 29 | SF | **3 SY** | |
| | | | | | | |
| **Bridge (over Chips Creek)** | spans: | 2 | l, w, d (ft): | 50 | 5 | 5 |
| **Substructure** | | | | | | |
| **Sediment & erosion control** | | | | | | |
| pier | | | 24 | LF | | |
| abutments | | | 50 | LF | | |
| | | | | | **74 LF** | |
| | | | | | | |
| **Clearing (included above)** | | | | | | |
| | | | | | | |
| **Excavation** | number | length (ft) | width (ft) | depth (ft) | volume | |
| pier | 1 | 4 | 4 | 4 | 64 | CF |
| abutments | 2 | 13 | 4 | 4 | 416 | CF |
| | | | | | 480 | CF |
| | | | | | **18 CY** | |
| | | | | | | |
| **Concrete** | | | | | | |
| pier footing | 1 | 4 | 4 | 3 | 48 | CF |
| pier | 1 | 5 | 2 | 2 | 20 | CF |
| pier cap | 1 | 5 | 2 | 2 | 20 | CF |
| abutments | 2 | 13 | 4 | 4 | 416 | CF |
| | | | | | 504 | CF |
| | | | | | **19 CY** | |

| Yellow Creek CW Pipeline | | | | | | |
|---|---|---|---|---|---|---|
| Quantity details | | | | | | |
| | | | | | | |
| **Superstructure** | number/span | length (ft) | weight (lb/ft) | weight | | |
| chords (6 x 4 x 0.375) | 4 | 50.0 | 25.5 | 10208 | LB | |
| struts (4 x 4 x 0.25) | 22 | 5.0 | 13.6 | 2994 | LB | |
| diagonals (2 x 4 x 0.1875) | 20 | 7.1 | 7.7 | 2166 | LB | |
| supports (6 x 6 x 0.375) | 22 | 5.0 | 30.6 | 6738 | LB | |
| braces (2 x 2 x 0.1875) | 22 | 5.0 | 5.1 | 1123 | LB | |
| | | | | | | **11.6 TN** |
| | | | | | | |
| **Pipe supports** | | | | | | **21 EA** |
| | | | | | | |
| | | | | | | |
| **Pipe - Rock Creek Dam to discharge** | | | | | | |
| | | | | | | |
| **Sediment & erosion control (does not include Chips Creek)** | | | | | | **56 LF** |
| | | | | | | |
| **Traffic control** | | | | | | **83 LF** |
| | | | | | | |
| **Clearing** | length (ft) | area (sf/ft) | area | | | |
| | 0 | 0 | 0 | SF | | **0 SY** |
| | | | | | | |
| **Excavation** | length (ft) | area/lf (sf) | volume | | | |
| trench | 139 | 48.62 | 6758 | CF | | |
| | | | 250 | CY | | |
| | rock | 75% | | | | **187 CY** |
| | earth | 25% | | | | **63 CY** |
| | | | | | | |
| **Furnish & install pipe (does not include specials)** | | | | | | |
| 36-in reinf conc pipe | | | | | | **139 LF** |
| 36-in steel pipe, concrete coated and lined | | | | | | **155 LF** |
| | | | | | | |
| **Furnish & install bend anchor** | | 1 | EA | | | |
| rock excavation | 4 | 5 | 4 | | | **9 CY** |
| rock bolts | 4 | 30 | | | | **120 LF** |
| reinforced concrete | 4 | 5 | 6 | | | **13 CY** |
| anchor rings | | | | | | **2 EA** |
| | | | | | | |
| **Furnish & install slope pipe anchors** | | 3 | EA | | | |
| rock excavation | 2 | 5 | 2 | | | **2 CY** |
| rock bolts | 4 | 30 | | | | **360 LF** |
| reinforced concrete | 2 | 5 | 4 | | | **4 CY** |
| anchor rings | | | | | | **3 EA** |
| | | | | | | |
| **36-in manually-operated butterfly valve** | | | | | | **1 EA** |
| | | | | | | |
| **Fill** | length (ft) | volume (cf/ft) | volume | | | |
| bedding | 139 | 2.50 | 348 | CF | | **13 CY** |
| select fill | 139 | 35.56 | 4943 | CF | | **183 CY** |
| | | | | | | |
| **Stairs** | | | | | | |
| structural steel | 202.1 | 89.6 | 124.42 | | | **5.5 TN** |
| grating | 5.5 | 4.00 | 8.00 | | | **176 SF** |
| treads | 96 | 3.00 | 0.83 | | | **240 SF** |
| handrailing | 404.2 | 179.2 | 171.5 | | | **755 LF** |
| | | | | | | |
| | | | | | | |
| **Pipe - specials** | | | | | | |
| | | | | | | |
| **Sediment & erosion control (included with main pipe)** | | | | | | **0 LF** |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Yellow Creek CW Pipeline** | | | | | | |
| Quantity details | | | | | | |
| | | | | | | |
| **Traffic control (included with main pipe)** | | | | | | **0 LF** |
| | | | | | | |
| **Clearing (included with main pipe)** | | | | | | **0 SY** |
| | | | | | | |
| **Detail 1 (Indian Creek)** | | quantity: | 1 | | length (ft): | 16 |
| **Excavation** | | area/lf (sf) | volume | | | |
| box culvert | | 43.02 | 688 | CF | | |
| | | | 25 | CY | | |
| | rock | 52% | | | | **13 CY** |
| | earth | 48% | | | | **12 CY** |
| | length (ft) | area/lf (sf) | volume | | | |
| transitions | 8 | 41.26 | 330 | CF | | |
| | | | 12 | CY | | |
| | rock | 53% | | | | **6 CY** |
| | earth | 47% | | | | **6 CY** |
| | | | | | | |
| **Fill** | | | | | | |
| box culvert | length (ft) | volume (cf/ft) | volume | CF | | |
| bedding | 16 | 3.68 | 59 | CF | | **2 CY** |
| select fill | 16 | 10.58 | 169 | CF | | **6 CY** |
| grouted riprap | 16 | 10.38 | 166 | CF | | **6 CY** |
| shoulder repair | 16 | 2.44 | 39 | SF | | **4 SY** |
| | | | | | | |
| transitions | | | | | | |
| bedding | 8 | 3.09 | 25 | CF | | **1 CY** |
| select fill | 8 | 13.05 | 104 | CF | | **4 CY** |
| grouted riprap | 8 | 10.11 | 81 | CF | | **3 CY** |
| shoulder repair | 8 | 2.44 | 20 | SF | | **2 SY** |
| | | | | | | |
| **Detail 2 (Pauls Creek and Murphy Creek)** | | quantity: | 2 | | length (ft): | 9 |
| **Excavation** | | area/lf (sf) | volume | | | |
| box culvert | | 43.02 | 774 | CF | | |
| | | | 29 | CY | | |
| | rock | 52% | | | | **15 CY** |
| | earth | 48% | | | | **14 CY** |
| | length (ft) | area/lf (sf) | volume | | | |
| transitions | 16 | 41.26 | 660 | CF | | |
| | | | 24 | CY | | |
| | rock | 53% | | | | **13 CY** |
| | earth | 47% | | | | **11 CY** |
| | | | | | | |
| **Fill** | | | | | | |
| box culvert | length (ft) | volume (cf/ft) | volume | CF | | |
| bedding | 9 | 3.68 | 33 | CF | | **1 CY** |
| select fill | 9 | 10.58 | 95 | CF | | **4 CY** |
| grouted riprap | 9 | 10.38 | 93 | CF | | **3 CY** |
| shoulder repair | 9 | 2.44 | 22 | SF | | **2 SY** |
| | | | | | | |
| transitions | | | | | | |
| bedding | 16 | 3.09 | 49 | CF | | **2 CY** |
| select fill | 16 | 13.05 | 209 | CF | | **8 CY** |
| grouted riprap | 16 | 10.11 | 162 | CF | | **6 CY** |
| shoulder repair | 16 | 2.44 | 39 | SF | | **4 SY** |
| | | | | | | |
| **Detail 3 (minor culverts)** | | quantity: | 5 | | length (ft): | 6 |
| **Excavation** | | area/lf (sf) | volume | | | |
| box culvert | | 43.02 | 1291 | CF | | |
| | | | 48 | CY | | |
| | rock | 52% | | | | **25 CY** |
| | earth | 48% | | | | **23 CY** |

| Yellow Creek CW Pipeline | | | | | | |
|---|---|---|---|---|---|---|
| Quantity details | | | | | | |
| | | | | | | |
| | length (ft) | area/lf (sf) | volume | | | |
| transitions | 40 | 41.26 | 1650 | CF | | |
| | | | 61 | CY | | |
| | rock | 53% | | | **33 CY** | |
| | earth | 47% | | | **28 CY** | |
| | | | | | | |
| **Fill** | | | | | | |
| box culvert | length (ft) | volume (cf/ft) | volume | CF | | |
| bedding | 6 | 3.68 | 22 | CF | **1 CY** | |
| select fill | 6 | 10.58 | 63 | CF | **2 CY** | |
| grouted riprap | 6 | 10.38 | 62 | CF | **2 CY** | |
| shoulder repair | 6 | 2.44 | 15 | CF | **1 CY** | |
| | | | | | | |
| transitions | | | | | | |
| bedding | 40 | 3.09 | 124 | CF | **5 CY** | |
| select fill | 40 | 13.05 | 522 | CF | **19 CY** | |
| grouted riprap | 40 | 10.11 | 404 | CF | **15 CY** | |
| shoulder repair | 40 | 2.44 | 98 | CF | **4 CY** | |
| | | | | | | |
| **Furnish & install transitions - round to rectangular** | | | 16 | EA | **64 LF** | |
| reinforced concrete | avg area (sf): | 6.77 | volume (cf): | 433 | **17 CY** | |
| | | | | | | |
| **Furnish & install box culverts** | | | | | **64 LF** | |
| 1.5-ft x 4.7-ft reinf conc | area (sf): | 10.05 | volume (cf): | 643 | **24 CY** | |
| | | | | | | |

| Yellow Creek CW Pipeline | | |
|---|---|---|
| Summary of Quantities | | |
| | | |
| Traffic Control | 14,789 | LF |
| | | |
| Sediment and erosion control | 16,917 | LF |
| | | |
| Clearing (incl trees) | 3,425 | SY |
| Clearing | 9,799 | SY |
| | | |
| Excavation, Rock | 15,096 | CY |
| Excavation, Earth | 9,833 | CY |
| | | |
| Concrete | 286 | CY |
| Concrete Encasement | 43 | CY |
| | | |
| Stop Log Sills | 35 | LF |
| Stop Log Slot Embeds | 60 | LF |
| Stop Logs | 226 | LF |
| | | |
| 36-inch Slide Gate | 1 | EA |
| 36-in manually-operated butterfly valve | 1 | EA |
| | | |
| Steel, Galvanized | 11.2 | TN |
| Steel, Painted | 17.3 | TN |
| Grating | 176 | SF |
| Stair Treads | 240 | SF |
| Handrailing | 755 | LF |
| | | |
| Wood, Treated | 22,080 | BF |
| | | |
| Select Fill | 10,175 | CY |
| Gravel Surfacing | 171 | CY |
| Bedding | 1,496 | CY |
| Riprap | 585 | CY |
| Riprap, Grouted | 5,369 | CY |
| Shoulder Repair | 3,989 | SY |
| | | |
| Guardrail Removal & Reinstallation | 12,940 | LF |
| | | |
| 24-inch CMP | 20 | LF |
| | | |
| Furnish & Install 36-in RCP | 15,952 | LF |
| Furnish & Install Transitions - Round to Rectangular | 64 | LF* |
| Furnish & Install Box Culverts | 64 | LF* |
| Furnish & Install 36-in Stl Pipe, Conc Coated & Lined | 155 | LF |
| | | |
| Pipe Supports (bridge over Chips Creek) | 21 | EA |
| | | |
| Sawcutting | 132 | LF |
| Pavement Removal | 44 | SY |
| Pavement Replacement | 44 | SY |
| | | |
| Rock Bolts | 480 | LF |
| Anchor Rings | 5 | EA |
| | | |
| * concrete volume included above | | |

# *Appendix D – Heat Gain Calculation*

| | | | |
|---|---|---|---|
| Owner | PG&E | Computed by | AWL |
| Project | Yellow Creek | Date | 19-Jan-05 |
| Project No | 133626 | | |
| Title | Heat Transfer to concrete pipe | | |

## Assumptions:

| | | |
|---|---|---|
| pipe diameter | **3** ft | 0.915 m |
| pipe thickness | **4** in | 0.102 m |
| concrete pipe | | |
| ambient temp | **90** F | 305.2 K |
| water temp | **15** ℃ | 288 K |
| $K_{grouted\ riprap}$ | | **2** W/(mK) |
| $K_{concrete}$ | | **1.4** W/(mK) |
| $\varepsilon_{grouted\ riprap}$ | | **0.88** |
| g | | 9.81 $m/s^2$ |
| head loss | **62.5** ft | 19.05 m |
| spec heat $C_{water}$ | | **4184** J/Kg*K |
| width of grout | | 1.119 m |
| length of pipeline | **16160** ft | 4927 m |
| grout cover | **1** ft | 0.305 m |
| flow | **50** cfs | 1.417 $m^3/s$ |
| mass flow rate | | 1414 kg/s |
| velocity | 7.1 ft/s | 2.165 m/s |
| viscosity | | **0.00000112** $m^2/s$ |

Heat transfer from grouted riprap to air by convection is negligible
Heat from pipe friction is not negligible; energy gained as heat = energy of head loss (starting point is nearly still pool, ending point is nearly still pool)

## Calculations

### Part I

**Heat addition from friction:**

$$\dot{Q}_{net} = \dot{m}^{*}\left(u_2 - u_1 + \left(\left(\frac{p_2}{\rho_2}\right) - \left(\frac{p_1}{\rho_1}\right)\right) + \left(\frac{v_2^2}{2} - \frac{v_1^2}{2}\right) + g(z_2 - z_1)\right)$$

Simplifying, drop heat transfer across boundary (handled separately in part II) pressure and velocity terms

$$0 = \dot{m}^{*}\left(u_2 - u_1 + g^{*}(z_2 - z_1)\right)$$

$$\frac{u_2 - u_1}{c} = \frac{g^{*}(z_2 z_1)}{c}$$

note that $$T_2 - T_1 = \frac{u_2 - u_1}{c}$$

T2-T1= 0.045 ℃

**Part II**
**Heat transfer to pipe from radiation:**

Incoming solar radiation

$G_{s,o}=S_c*f*\cos\theta$

| | | | |
|---|---|---|---|
| $S_c$= | **1353** | W/m$^2$ | (solar radiation information taken from Fundamentals of Heat and Mass Transfer) (Solar radiation constant) |
| f= | **1.03** | | (Orbital correction factor for eliptical orbit around the sun) |
| θ= | **10** | | (Angle that the light from the sun makes with a line normal to the surface) |

$G_{s,o}$= 1372 W/m$^2$

Total incoming solar energy

$$Q = G_{s,o} * w * l$$

Q= 7,564,265 W

Set incoming solar energy equal to energy conducted to water and energy radiated to surroundings

Thermal resistances
$R_1$ is resistance to radiation loss
$R_2$ is resistance to conduction through grout
$R_3$ is resistance to conduction through pipe
$R_4$ is resistance to convection inside pipe

$$R_1 = \frac{1-\varepsilon}{\varepsilon * A}$$

$$R_2 = \frac{L}{k_{grout} * A}$$

$$R_3 = \frac{\ln\left(r_2/r_1\right)}{2 * \pi * l * k_{concrete}}$$

$$R_4 = \frac{1}{h * 2 * \pi * r_1 * l}$$

$$h = \frac{Nu * k_{water}}{d}$$

$$Nu = 0.023 * \mathrm{Re}_d^{.8} * \mathrm{Pr}^{.4}$$

| | | |
|---|---|---|
| ε= | 0.88 | |
| A= | 5513.313 | m$^2$ |
| L= | 0.7625 | m |
| $k_{grouted\ riprap}$ | 2 | W/(m*K) |
| $r_2$= | 0.5595 | m |
| $r_1$= | 0.4575 | m |
| l= | 4927 | m |
| $K_{concrete}$= | 1.4 | W/(m*K) |
| Pr= | **7.56** | |
| Re= | 1768728 | |

| | | |
|---|---|---|
| Nu= | 5144 | |
| $k_{water}$= | **0.598** | W/(m*K) |
| h= | 3362 | W/($m^2$*K) |

| | | |
|---|---|---|
| $R_1$= | 2.47335E-05 | $1/m^2$ |
| $R_2$= | 6.91508E-05 | K/W |
| $R_3$= | 4.64388E-06 | K/W |
| $R_4$= | 2.10014E-08 | K/W |

$$Q = \frac{(5.67*10^{-8)} T_{surface}^4 - T_{ambient}^4}{R_1} + \frac{T_{surface} - T_w}{R_2 + R_3 + R_4}$$

9.31323E-09

$T_s$= 329.12 K

Energy gained by water

| | | |
|---|---|---|
| Q= | 557,046 | J/s |
| ΔT= | 0.094 | ℃ |

**$\Delta T_{total}$= 0.14 ℃**