BASIS OF REASONING FOR BASE COSTS

California Geologic Energy Management Division
Cost Estimate Regulations for Oil and Gas Operations

Public Resources Code section 3205.7 requires each operator of an oil or gas well, including an underground gas storage well, to submit a report to the Department of Conservation's Geologic Energy Management Division (CalGEM) estimating the cost to plug and abandon each of its wells, decommission each of its attendant production facilities, and complete any needed site remediation. As required by Senate Bill 551 (Jackson, Ch. 774, Stats. of 2019), CalGEM has developed a set of criteria for these reports, promulgated as the Cost Estimate Regulations for Oil and Gas Operations (the proposed regulations) under the Administrative Procedures Act.

The proposed regulations include two methods for operator compliance. Under Method 1, operators are provided base numbers that are adjusted for weighted characteristics to generate a cost estimate. Under Method 2, operators generate a cost estimate that accounts for a list of cost items specified by the proposed regulations and must provide documentation to support how the cost estimate was generated.

The purpose of this document is to provide a technical summary of ways in which state contracting data, operator data, and independent contractor data were used to generate the base numbers and weighted characteristics that are provided in the proposed regulations.

1. Method 1 Background

The proposed regulations include an approach for conducting cost estimates referred to as "**Method 1**."

Method 1 provides operators with base numbers for estimating the costs to plug and abandon their wells, decommission attendant production facilities, and complete site remediation based upon the region in which the work is being done. Multipliers are then applied to the base numbers to adjust for the specific well, production facility, and site characteristics that are known to increase the costs associated with these activities.

Salvage values are not included in state contracts and are not accounted for in the base costs established in Method 1. The state contract data was adjusted for inflation using the Consumer Price Index (CPI) for all urban consumers, series CUUR0000SA0, not seasonally adjusted.

To establish the base numbers proposed for use in Method 1, CalGEM conducted a comprehensive review and analysis of past well plugging and abandoning (P&A), production facility decommissioning work, and site remediation conducted by the state from 2011 to 2020. CalGEM analyzed all costs incurred by the state to plug and abandon each well, decommission each production facility, and complete site remediation (i.e., equipment rental rates, service charges, and personnel rates) as reported and invoiced by the contractors. In addition, CalGEM reviewed all pertinent technical and status details about each well, production facility, and site at the time the work was performed, including the well history, geologic information, drilling history, subsurface information, surface and location characteristics, and production facility specifications to determine those characteristics that increase the costs of the work.

An overview of the consolidated data used in the analysis is shown in the table below. The data are representative of oil and gas operations statewide and is based on 109 wells located in 61 different oil fields. Ten production facility settings (locations where facilities are grouped together) were also evaluated, including over 40 tanks and vessels and other attendant production facilities.

Table 1. Summary of State Contract Data used to Develop Method 1

• Review Period	2011 – 2020 (10 years)
• Total Number of Contracts	33 (11 contractors)
• Total Number of Wells Plugged and Abandoned	109
• Total Number of Oil & Gas Fields	61 (across 4 Regions)
• Total Number of Production Facility Settings	10
• Average Age of Wells	50 years

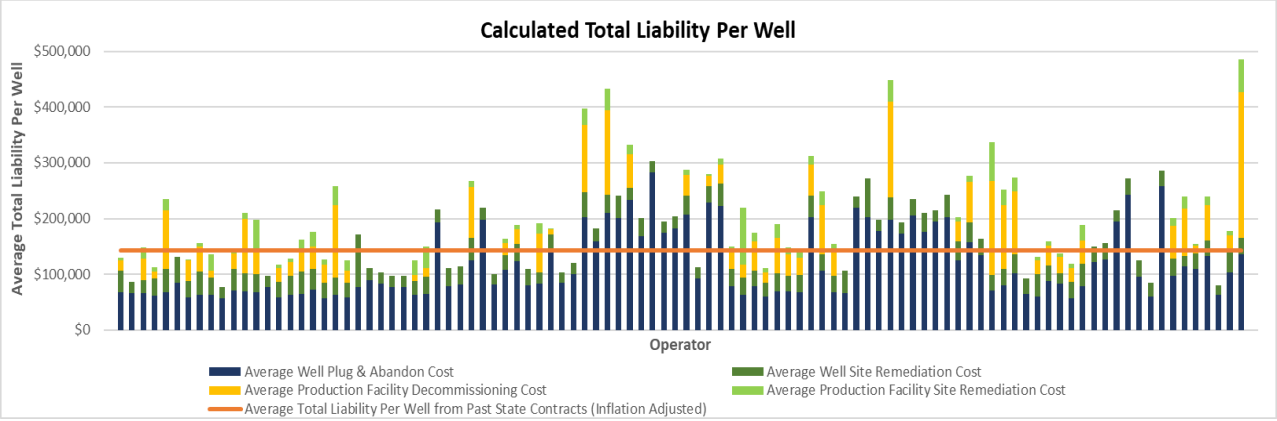
2. Testing of Cost Estimate Methodology

To test the Method 1 methodology and compare against the historical state costs and independent studies, CalGEM used the Method 1 base numbers, aggregate risk scoring system, other project components, and contingency to calculate the total estimated liability costs for various operators across the Central, Northern, and Southern regions of the state. The total liability costs include well P&A, production facility decommissioning, and site remediation. The liability costs for each operator were calculated well by well and facility by facility and aggregated together to generate a total liability cost per operator. The operations for a total of 100 operators were evaluated including 1,466 wells, 823 tanks, 259 vessels, other attendant production facilities, and site remediation.

From the 100 operators evaluated, the average per well cost was calculated to be $93,427 for P&A, $26,994 for production facility decommissioning, $29,506 for well site remediation and $15,684 for production facility site remediation, resulting in a total liability per well of $165,611. This calculated total liability is in line with the average total liability of $143,108 (inflation adjusted) from the historical state contracts. Figure 1 displays the total liability per well of the 100 operators evaluated and compared against the state contract average.

The calculated production facility decommissioning, well site and production facility site remediation totals $72,184 per well and is comparable to the $56,000 per well surface reclamation cost estimated in the Environmental Science & Technology article[1] in their evaluation of decommissioning costs of more than 19,500 oil and gas wells across multiple states.

Figure 1- Calculated Average Total Liability Per Well for Operators Across California.



3. Well Plugging and Abandonment

To develop the base numbers for Method 1 specific to well P&A, CalGEM reviewed the information available about each well that has been plugged and abandoned under a state contract, and categorized wells based on region, specific well characteristics (i.e., well depth, wellbore configuration, perforation zones, etc.), complexity of operations (i.e., fishing operations, bridge plugs, casing integrity issues, etc.), and other risk factors (critical well, etc.)

The analysis involved a detailed statistical review of the cost data by region and well category using the Power BI statistical software. As a result of the analysis, CalGEM learned that the primary driver of well P&A costs appears to be the number of days required to complete the abandonment operation. The analysis also shows a variation in each region in the number of days and daily cost rate to plug and abandon a well, therefore for each region, a benchmark value to plug and abandon a base well and the associated daily cost rate was established.

The varying costs between the different regions can be attributed to various factors including: central region having lower rig costs and greater oilfield contractor availability; southern region having a highly urbanized area, limited work hours, higher rig costs, and less oilfield contractor availability; northern region having hilly and mountainous topography, more environmentally sensitive areas, longer travel distance, and less oilfield contractor availability.

The Power BI statistical review was used to quantify the impact of each well characteristic and output the following statewide and regional statistics that were used in Method 1: median well P&A days, median daily cost, average well age, and average well depth as shown in Figures 2-4 below. Median values were used as the benchmark for the base well in each region. Average values were not used due to the presence of outliers skewing the data.

From this analysis, the base cost for a well in each region was developed by identifying a well that met the following three criteria:

a. A simple wellbore configuration;

b. No health, safety and environmental risk; and

c. No known downhole issues or well complications. (e.g., junk in hole, inadequate casing or inadequate tubing integrity, etc.)

Where such a well did not exist in a specific region, the well most closely approaching these criteria on balance was used as a starting point, and then a derived base cost value was generated by estimating adjustments to the actual abandonment costs as if the well did have characteristics meeting these criteria.

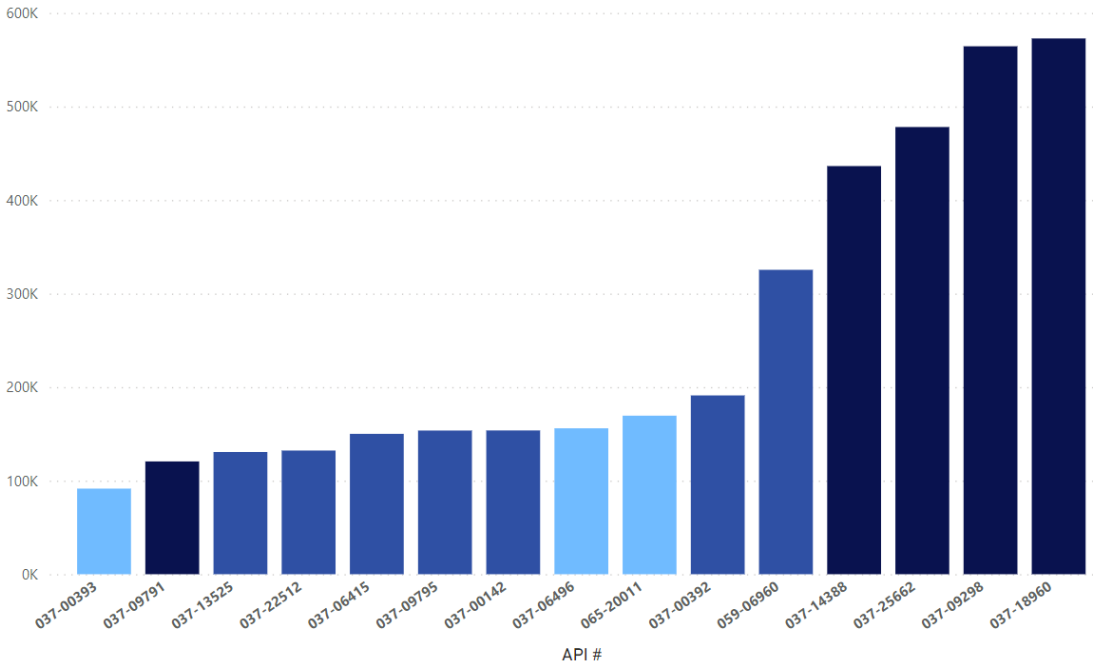
For validation purposes, the analysis incorporated other P&A data voluntarily supplied by operators in response to Notice to Operators (NTO) 2021-09 (November 19, 2021), and cost estimate studies conducted by an independent contractor, including estimates of costs and P&A days. The established benchmark values were compared to this third-party data to validate the conditions defining a base well and develop graphic comparisons of primary statistics. The analysis found that variances were small. See the appendix for data references.

4. Well Cost Analysis Output by Region

The state well cost data represented in the graphics below are color coded by level of complexity and risk associated with the P&A operation.

a. Southern Region

Figure 2- Total P&A Cost by API

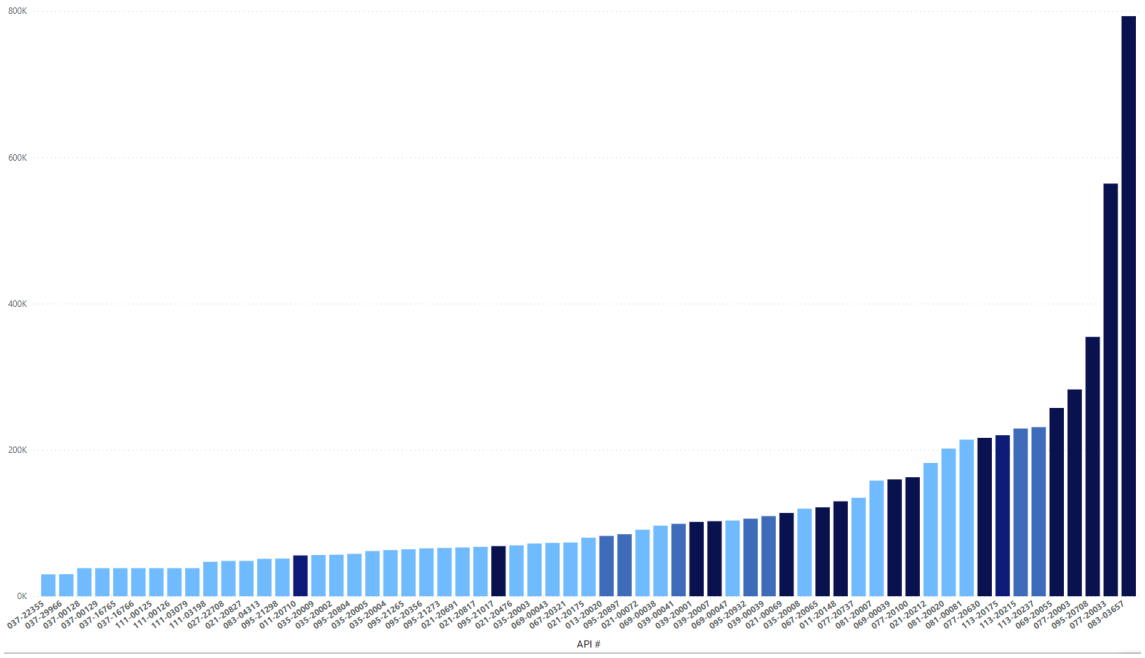


			Benchmark* (Base Well)	
Number of P&A Wells	Average Well Depth	Average Well Age	Median Well P&A Days	Median Daily Cost
15	5,079 ft	61	**14**	**$12,500**

*Note: The median well P&A days and median daily cost was used as the benchmark for a base well in the Southern Region.

b. Northern Region

Figure 3- Total P&A Cost by API

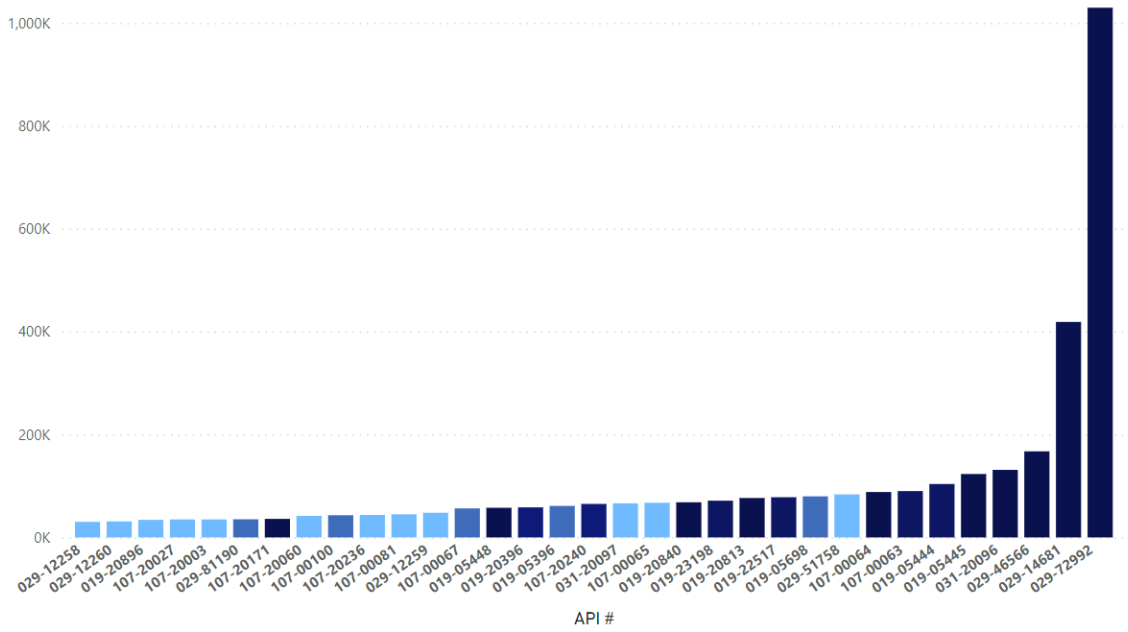


Number of P&A Wells	Average Well Depth	Average Well Age	**Benchmark* (Base Well)** Median Well P&A Days	Median Daily Cost
61	4,088 ft	43	**8**	**$12,000**

*Note: The median well P&A days and median daily cost was used as the benchmark for a base well in the Northern Region.

c. Central Region

Figure 4 - Total P&A Cost by API



Number of P&A Wells	Average Well Depth	Average Well Age	**Benchmark* (Base Well)** Median Well P&A Days	Median Daily Cost
33	3,641 ft	53	**10**	**$7,000**

*Note: The median well P&A days and median daily cost was used as the benchmark for a base well in the Central Region.

5. Aggregated Well Score System

Under Method 1, the cost estimate is then adjusted from the base well by applying points based upon the known characteristics of the well into the cost calculations. The point system for the aggregated well score for Method 1 for well abandonment is designed to systematically consider and account for those characteristics that, based on engineering realities and operational experience, are known to impact the overall scope of work and cost required to safely plug and abandon a well in compliance with all requirements of state law.

The assigned points for each characteristic provide a numerical method to incorporate cost impacts for specific operational activities that will be necessary to plug and abandon a well. These characteristics (i.e., well depth, well configuration, number of isolation zones, etc.) influence the amount of work and associated cost required to properly plug and abandon the well and are incorporated to adjust the base cost for those impacts. Other characteristics incorporated into the score account for the level of uncertainty or operational challenges anticipated while carrying out the P&A work such as environmental risk, junk-in-hole, and issues with casing integrity.

The points assigned to each characteristic and the distribution of the score is based on a combination of the necessary operational activities to complete the well P&A, and the weighted impact of each risk factor as determined from professional experience of CalGEM engineers and geologists, existing research on industry P&A practice, and impacts on costs in past well P&A work reported to the State.

Assigned points range from 0 to 10 for individual characteristics and up to 25 for the unknown well condition characteristic. The higher the aggregated well score, the more complex the well, and the higher the level of operational challenges or uncertainty expected while carrying out the P&A work.

The statistical analysis and methodology used to develop the scores involved the following:

a. Using state contract data for each region, compute the median days to plug and abandon a well for which there were no risk factors or operational challenges.

b. Compute the median well days to plug and abandon similar wells with the presence of a selected risk factor.

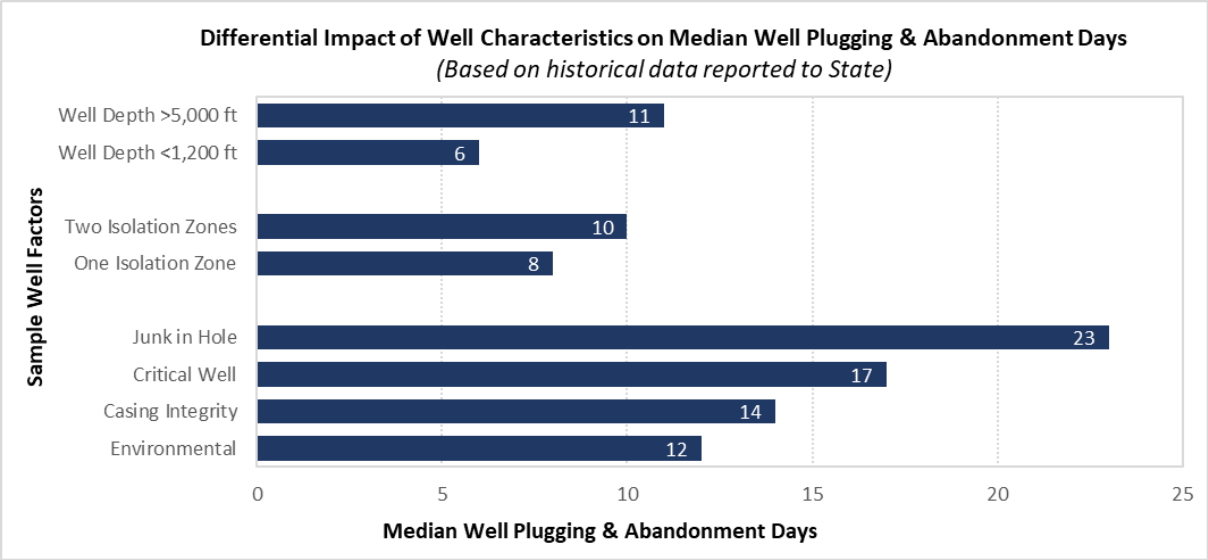
c. Compare the median values from (a) and (b) above to determine the differential impact of the added factor and assign a weighted score based on that differential using interpolation.

d. Repeat the process (a) to (c) iteratively to assign a weighted score for each factor.

e. Calibrate and test as required to determine a representative weighted score for each characteristic.

For reference, Figure 5 shown below is a graphical distribution of historical well P&A averages for a sample of well factors.

Figure 2- Differential Impact of Well Characteristics on Median Well P&A Days



6. Production Facility Decommissioning

To develop the base cost for decommissioning a production facility setting, CalGEM reviewed the data for each production facility that had been decommissioned under a state contract as discussed in section 1 and utilized average historical costs from those state contracts to calculate unit costs for each element of the decommissioning[13,14]. The analysis used to compute the unit costs shown in Figures 6 and 7 involve the following:

a. Using the state contract data, allocate reported costs to the appropriate production facility by type for each facility.

b. Using the data in CalGEM's records, verify production facility details such as size and capacity, to determine facility variations affecting cost.

c. Calculate the Method 1 unit cost for each facility type and variation by calculating the average cost for each as reported in the state contract data.

For validation purposes, the analysis incorporated other production facility decommissioning data voluntarily supplied by operators, and cost estimate studies conducted by an independent contractor. Section 2 provides an insight into comparing the Method 1 estimated total liability costs against the historical state costs.

Figure 3- Tank Decommissioning Unit Costs by Size

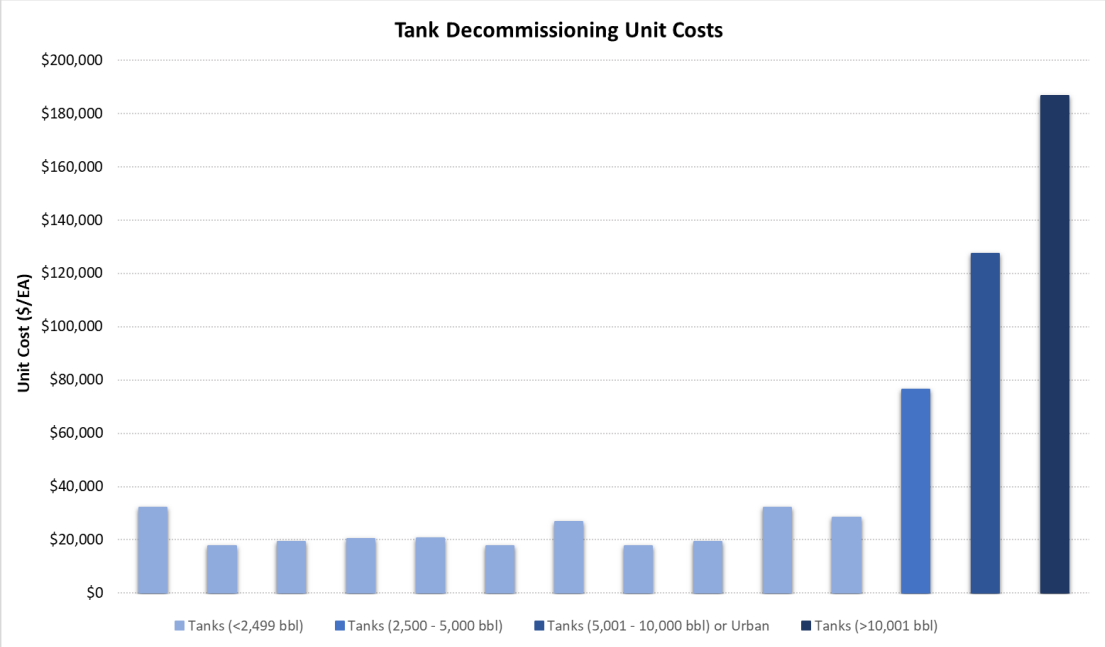
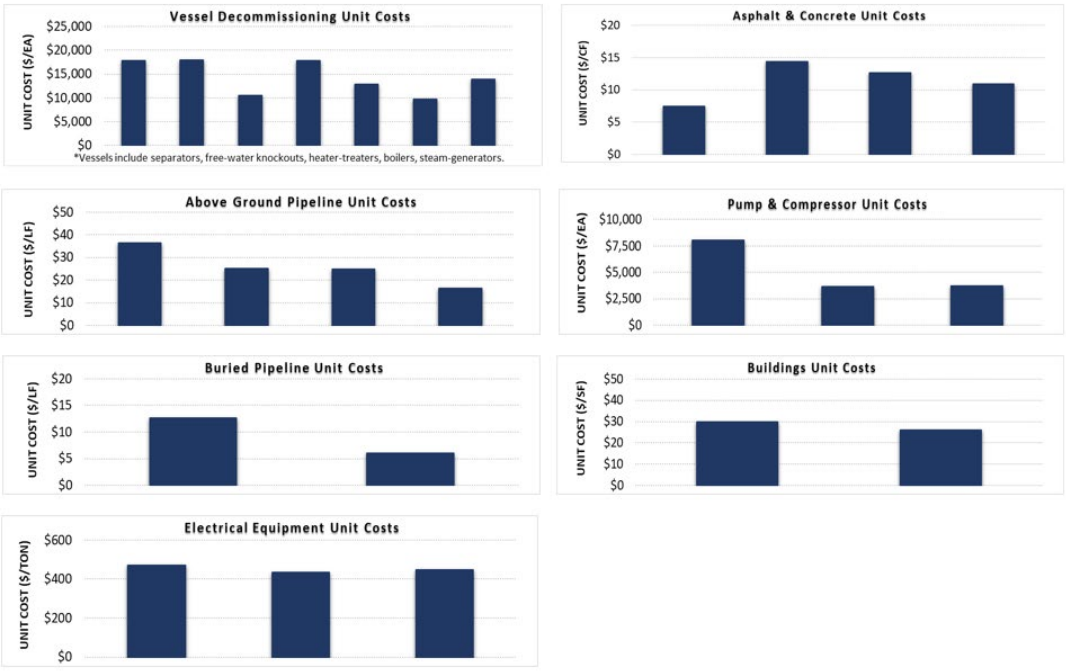


Figure 4- Production Facility Decommissioning Unit Costs



7. Site Remediation

To develop the base numbers for site remediation, CalGEM utilized historical costs from state contracts as discussed in section 1 above. CalGEM also reached out to waste management facilities in California for rates to dispose of soil and other removed material such as refuse, trash, and debris. The unit costs for soil excavation and site restoration incorporated into the proposed regulations were generated through a detailed review of well site or facility site cost data, WellSTAR data and surface characteristics. The surface coordinates from WellSTAR were used to view aerial images of the site. The pre- and post-restoration images of the site were used to calculate the amount of restoration completed.

The site remediation costs for removal of a tank, vessel, or well were computed by multiplying the unit costs and the volumes shown in Figure 8 and 9. These volumes were referenced from CalGEM field inspections and cost estimate studies conducted by an independent contractor[12].

The site remediation costs for tanks, vessels, wells, sumps, auxiliary holes, and well cellars consist of soil excavation and disposal, refuse removal, and site restoration. Site restoration includes backfilling excavations, compaction, slope collapse mitigation, and returning the site back to its natural state. The site remediation scope of work is in accordance with California Code of Regulations, title 14, section 1776.

To account for the site remediation for those areas outside of the tank, vessel, or well disturbed by oil and gas operations, an additional 25 percent for tanks and vessels and 10 percent for wells were added onto the site remediation cost. The amount of site remediation required can vary greatly and requires soil sampling and testing to reliably determine the amount of additional remediation required. From engineering experience from previous completed projects, it has shown that 25 percent for tanks and vessels and 10 percent for wells has been the average amount of additional site remediation required for areas outside a tank, vessel, and well.

The sump remediation unit cost was computed by taking the summation of the site restoration, soil excavation, and soil disposal unit costs as shown in Figure 10. The amount of soil contamination within a sump can vary greatly and requires soil sampling and testing to confirm the extent of impact. An initial one-third of the original sump depth was used to account for soil to be excavated and disposed of, resulting in a sump remediation unit cost of $4.37/cubic foot (CF) ($5.10/CF adjusted for inflation) which is comparable to the average unit cost of $4.12/CF calculated from the cost estimate studies conducted by an independent contractor.

For validation purposes, the analysis incorporated other site remediation data voluntarily supplied by operators. Figure 11 shows an example of a validation method used for the well site remediation cost. Subsurface and surface hours spent on various well abandonments were voluntary submitted by operators in response to NTO 2021-09. The average surface hours supplied by the operator were multiplied by the Method 1 well base costs to compute an approximate well site remediation cost for each district and is comparable to the Method 1 well site remediation cost with the other project components and contingency added in. Section 2 provides an insight into comparing the Method 1 estimated total liability costs against the historical state costs.

Figure 5- Site Remediation Unit Costs for Wells, Tanks, Vessels

			Well		Vessels		Tanks (<2.5k bbl)		Tanks (2.5-5k bbl)		Tanks (5-10k bbl)		Tanks (>10k bbl)	
	Unit	Unit Cost	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity
Soil Excavation	CF	$0.79	$304	384	$349	441	$349	441	$1,423	1,800	$3,795	4,800	$8,550	10,816
Soil Disposal	TON	$184	$2,863	16	$3,288	18	$3,288	18	$13,419	73	$35,785	194	$80,635	438
Site Restoration	CF	$1.76	$677	384	$778	441	$778	441	$3,175	1,800	$8,467	4,800	$19,080	10,816
Trash/Refuse Removal	CY	$153	$1,529	10	$1,529	10	$1,529	10	$1,529	10	$1,529	10	$1,529	10
Access Road Removal & Restoration	CF	$2.73	$5,458	2,000	$0	0	$0	0	$0	0	$0	0	$0	0
Areas Outside a Tank, Vessel, or Well			$1,083	10%	$1,486	25%	$1,486	25%	$4,887	25%	$12,394	25%	$27,449	25%
Total Site Remediation Cost			$11,914		$7,429		$7,429		$24,433		$61,970		$137,243	

Figure 6- Assumed Site Remediation Volumes for Wells, Tanks, Vessels

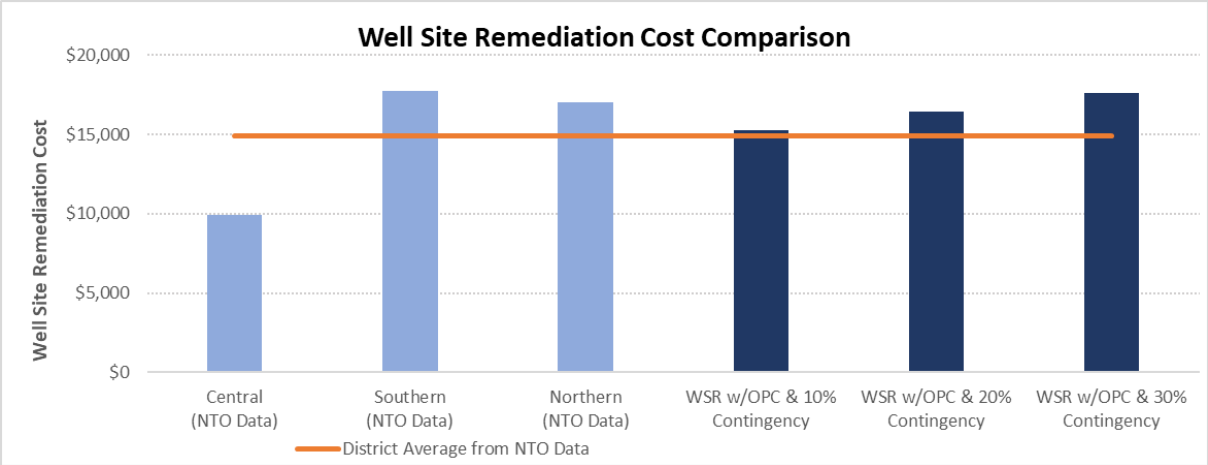
	Unit	Tank	Well	Vessel	Notes
Soil Excavation, Disposal & Site Restoration Per Well	CF		384		8 x 8 x 6 ft area and depth per well
Soil Excavation, Disposal & Site Restoration Per Vessel	CF			441	21 x 21 x 1 ft area and depth per vessel
Soil Excavation, DIsposal & Site Restoration Per Tank (<2.5k bbl)	CF	441			21 x 21 x 1 ft area and depth per tank (<2.5k bbl)
Soil Excavation, DIsposal & Site Restoration Per Tank (2.5k-5k bbl)	CF	1,800			30 x 30 x 2 ft area and depth per tank (2.5k-5k bbl)
Soil Excavation, Disposal & Site Restoration Per Tank (5k-10k bbl)	CF	4,800			40 x 40 x 3 ft area and depth per tank (5k-10k bbl)
Soil Excavation, Disposal & Site Restoration Per Tank (>10k bbl)	CF	10,816			52 x 52 x 4 ft area and depth per tank (>10k bbl)
Refuse Removal	CY	10	10	10	10 cubic yards of refuse per tank, well, vessel
Access Road Removal & Restoration	CF		2,000		100 x 20 x 1 ft or 200 x 10 x 1 ft of access road per well

Figure 7- Sump Remediation Unit Cost

Sump Remediation					
Unit Type	Unit Cost ($/CF)	Length LF	Width LF	Depth LF	Total Cost $
Site Restoration	1.45	100.0	30.0	13.3	$58,018
Soil Excavation & Disposal	7.31	100.0	30.0	3.3	$73,081
Total	4.37	100.0	30.0	10.0	$131,099

* Example assumes original 10 ft sump depth.

Figure 8- Well Site Remediation Cost Comparison Between NTO Data and Method 1 Cost



8. Other Project Components

Production facility decommissioning and site remediation cost estimates include costs for other project components including permitting and regulatory compliance activities, mobilization and demobilization costs, and project management and engineering. These project components are added to the production facility decommissioning and site remediation cost estimates given that there are more unknown variables and complexity compared to well plug and abandon operations. The percentages assigned to each project component were referenced from the US Environmental Protection Agency (EPA) cost estimating guide and the US Department of the Interior (DOI) handbook. The EPA cost estimating guide provides guidelines and concepts to generate cost estimates for environmental cleanup projects including facility and brownfield cleanups[9]. The DOI handbook provides standard engineering cost estimating procedures for reclamation projects[10].

Permitting and regulatory compliance activities, which include costs for permitting, soil sampling, fluid sampling, surveys, and other work required to comply with applicable provisions of the Public Resources Code and the California Code of Regulations, are estimated to account for 5 percent of the total production facility decommissioning and site remediation costs. The EPA guide recommends a percentage ranging from 6 percent to 20 percent depending on the size of the project cost but includes overlapping elements covered in project management and engineering, therefore, 5 percent is assigned for permitting and regulatory compliance.

Mobilization and demobilization, which includes the costs required for preparation work and operations necessary for the movement of equipment, supplies and personnel to and from the site, are estimated to account for 5 percent of the production facility decommissioning and site remediation costs. The DOI handbook recommends a percentage ranging from 1-5 percent depending on the type and number of equipment hauled and the distance to the site. Given the location of wells located in California in relation to necessary equipment and personnel, the greater distance and time to move equipment, supplies, and personnel to and from the site indicates 5 percent is appropriately assigned for mobilization and demobilization.

Project management and engineering, which includes costs for project management, engineering design, planning and reporting, etc., are estimated to account for 8 percent of the total production facility decommissioning and site remediation costs. The EPA guide recommends a percentage ranging from 5-10 percent depending on the size of the project cost. The historical state contracts averaged approximately $500,000 per contract, which the guide indicates should be assigned 8 percent for project management.

9. Contingency

The production facility and site remediation aggregated risk scores capture the amount of contingency to be added to a production facility decommissioning cost estimate and a site remediation cost estimate. The contingency is the amount added to an estimate to account for items, conditions, or events for which the occurrence and effect is uncertain and that experience shows will result in additional cost. The contingency for the well P&A cost estimates are accounted for in the Aggregated Well Score table.

As discussed above, the aggregated risk score incorporates various risk characteristics that may be present at a production facility and well site. The presence of a risk characteristic will add additional costs to decommissioning and site remediation, and therefore results in a higher cost estimate. An example of a risk characteristic is the age of a facility or site being greater than 50 years. Older facilities generally have a larger footprint compared to newer facilities, have more degraded conditions, and may have greater soil impacts given the longer operating lifespan.

The contingency amount is determined by the aggregated risk score. An aggregated risk score of <10 points adds 10 percent contingency, between 10 and 19 points adds 20 percent contingency, and >20 points adds 30 percent contingency. The higher the aggregated risk score, the higher the uncertainty of the costs.

The Association for the Advancement of Cost Engineering (AACE) International, a project controls and cost engineering professional association, provides guidelines for applying general principles of estimate classifications to project cost estimates. Figure 12 shows AACE's suggested cost estimate classes and the associated maturity level of project definition deliverables aligned with the methodology and expected accuracy range. The contingency range used in Method 1 is consistent with a Class 3 cost estimate given the expected end usage of the estimate, and the accuracy range and estimating methodology are acceptable for our purpose[7,8]. For most operators, a Class 3 estimate is the most reasonable estimate given the budget authorization end usage and preparation time required. Class 2 and Class 1 estimates require additional time, resources, and money to prepare and are typically done closer to the actual project commencing, and their value is valid for a shorter period of time due to the ever-changing market conditions. Class 4 and Class 5 estimates have a higher contingency range given the shorter preparation time and wider accuracy range.

Figure 9- AACE Cost Estimate Classification Matrix

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical +/- range relative to index of 1 (i.e. Class 1 estimate) [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or feasibility	Stochastic (factors and/or models) or judgment	4 to 20	1
Class 4	1% to 15%	Concept study or feasibility	Primarily stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget authorization or control	Mixed but primarily stochastic	2 to 6	3 to 10
Class 2	30% to 75%	Control or bid/tender	Primarily deterministic	1 to 3	5 to 20
Class 1	65% to 100%	Check estimate or bid/tender	Deterministic	1	10 to 100

Notes:
[a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50% (at an 80% confidence interval).
[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Appendix

State Well P&A Cost (2011 – 2020)

Region	Field	Well Name	API #	Well Depth	P&A Date	Original Cost	T&M Cost	Total Cost
Northern	Grimes Gas	"Ophelia" 1	011-20148	8575	7/23/2018	$50,705	$57,435	**$108,140**
Northern	Colusa County	"Yellow Rose" 1	011-20710	7322	2/10/2015	$39,600	$3,989	**$43,589**
Northern	Brentwood Gas	"Transcmerica-Maggiora" 2	013-20020	3911	7/9/2013	$38,850	$24,583	**$63,433**
Central	Raisin City	"Noble 13AM"	019-05396	4824	8/16/2017	$31,764	$18,000	**$49,764**
Central	Raisin City	"Noble" L-29-1	019-05444	4475	1/13/2015	$45,868	$35,265	**$81,133**
Central	Raisin City	"Noble" L-29-2	019-05445	4837	1/20/2015	$62,368	$33,935	**$96,303**
Central	Raisin City	"Noble L-29-5" 1	019-05448	4749	9/25/2017	$28,090	$18,758	**$46,848**
Central	San Joaquin	"Brackney" 1	019-05698	5490	10/9/2014	$62,368		**$62,368**
Central	Raisin City	"Waster Water Disposal" 2	019-20396	4245	10/28/2014	$45,663		**$45,663**
Central	Raisin City	"N.C.C. 4-A-10" 1	019-20813	5188	3/2/2018	$25,480	$38,373	**$63,853**
Central	Raisin City	"Noble" 1	019-20840	4890	11/24/2014	$53,368		**$53,368**
Central	Raisin City	"Noble 2" 1	019-20896	5002	10/26/2017	$27,795		**$27,795**
Central	Any Field	"Bains" A-1	019-22517	5763	1/9/2018	$26,085	$39,000	**$65,085**
Central	Any Field	"Noble WDI-5" 1	019-23198	2812	12/26/2017	$19,576	$39,970	**$59,546**
Northern	Willows-Beehive Bend	"Zumwalt" 3-63	021-00069	5618	8/27/2018	$75,800	$19,106	**$94,906**
Northern	Willows-Beehive Bend	"Zumwalt" 2-63	021-00072	5295	8/21/2018	$75,800		**$75,800**
Northern	Willows-Beehive Bend	"McElroy Gas Unit" 1	021-20175	4663	8/16/2018	$66,700		**$66,700**
Northern	Larkin, West, Gas	"Chevron TA" 1-29	021-20212	3514	6/24/2020	$155,692		**$155,692**
Northern	Willows-Beehive Bend	"Sul Norte Orchard" 1-30	021-20476	4690	5/17/2018	$57,953		**$57,953**
Northern	Ord Bend Gas	"Otto Lohse" 1-22	021-20691	5560	6/14/2018	$55,559		**$55,559**
Northern	Ord Bend Gas	"Finch" 1	021-20817	5680	3/23/2018	$56,302		**$56,302**
Northern	Ord Bend Gas	"Clementino" 1	021-20827	5620	5/29/2018	$40,268		**$40,268**
Coastal	Tapia	"Dodge-Kaye" 2-A	027-22708	1228	5/1/2013	$23,992	$13,136	**$37,128**
Central	Mount Poso	"Loudon" 1	029-12258	1756	4/16/2013	$23,290		**$23,290**
Central	Mount Poso	"Loudon" 2	029-12259	1775	4/16/2013	$23,189	$13,752	**$36,941**
Central	Mount Poso	"Loudon" 4	029-12260	1728	4/17/2013	$23,919		**$23,919**
Central	Mountain View	Union-Signal-Ancora-Tipton-Stockton #77-34	029-14681	9203	2/18/2020	$288,844	$69,151	**$357,995**
Central	McDonald Anticline	San Joaquin #11	029-46566	1923	4/27/2018	$128,826	$10,587	**$139,413**
Central	Temblor Hills	"Hotchkiss Unit" 24-25	029-51758	4116	4/24/2013	$43,715	$20,578	**$64,293**
Central	Mountain View	Cauzza et al Pool #01-03	029-72992	9044	11/6/2019	$260,106	$619,930	**$880,036**

Region	Field	Well Name	API #	Well Depth	P&A Date	Original Cost	T&M Cost	Total Cost
Central	Semitropic	"Hill" 67X	029-81190	3117	12/19/2014	$27,546		**$27,546**
Central	Trico Gas	"Anderson Unit 1" 1-12	031-20096	2545	7/2/2016	$21,997	$82,230	**$104,227**
Central	Trico Gas	"Anderson Unit 2" 2-12	031-20097	3306	7/12/2016	$20,588	$32,000	**$52,588**
Northern	Lassen County	B-J 901	035-20002	625	10/3/2020	$48,555		**$48,555**
Northern	Lassen County	W-W 902	035-20003	1518	9/29/2020	$61,650		**$61,650**
Northern	Lassen County	Bob Webber Drilling Co. 903	035-20004	880	9/22/2020	$53,910		**$53,910**
Northern	Lassen County	Bob Webber Drilling Co. 904	035-20005	889	9/23/2020	$52,815		**$52,815**
Northern	Lassen County	Don Dow 2	035-20008	3990	9/28/2020	$98,665	$3,677	**$102,342**
Northern	Lassen County	The Esther M -HLE 1	035-20009	550	10/3/2020	$48,175		**$48,175**
Coastal	Tapia	"Louise" 1	037-00128	1127	8/26/2015	$30,000		**$30,000**
Coastal	Tapia	"Royalty" 1	037-00129	1130	8/26/2015	$30,000		**$30,000**
Southern	Long Beach	"Nwibu" 9-5	037-00142	9454	9/19/2013	$118,000	$231	**$118,231**
Southern	Long Beach	"Nwibu" 9-6	037-00393	4175	9/12/2013	$70,400		**$70,400**
Southern	Long Beach	"Nwibu" 8-4	037-06415	5878	1/23/2014	$115,000	$2,237	**$117,237**
Southern	Long Beach	"Nwibu" 8-3	037-06496	6540	11/8/2013	$120,000		**$120,000**
Southern	Prado-Corona	Drake 1	037-09298	5298	10/8/2018	$478,308		**$478,308**
Southern	Long Beach	"Nwibu" 9-4	037-00392	9239	10/21/2013	$146,800	$231	**$147,031**
Southern	Long Beach	"Nwibu" 9-3	037-09791	4825	1/8/2014	$94,200		**$94,200**
Southern	Long Beach	"Nwibu" 5-1	037-09795	5533	2/5/2015	$120,000		**$120,000**
Southern	Long Beach	"Nwibu" 9-2	037-13525	5434	12/9/2013	$95,000	$7,079	**$102,079**
Southern	Rosecrans	Gordon 4	037-14388	5473	8/28/2018	$363,616		**$363,616**
Coastal	Tapia	"Dodge" 1	037-16765	1367	8/26/2015	$30,000		**$30,000**
Coastal	Tapia	"Louise" 3	037-16766	1067	8/26/2015	$30,000		**$30,000**
Southern	Los Angeles City	"Patel" 1	037-18960	1100	7/30/2016	$204,588	$250,000	**$454,588**
Coastal	Tapia	"Dodge'Kaye"4	037-22355	1212	5/3/2013	$23,047		**$23,047**
Southern	Long Beach	"Nwibu" 8-7	037-22512	4626	11/20/2013	$100,200	$1,511	**$101,711**
Southern	Los Angeles City	"Rogalske" 10	037-25662	1100	7/15/2018	$148,399	$250,000	**$398,399**
Coastal	Tapia	"Dodge-Kaye"5	037-29966	1247	5/1/2013	$23,175		**$23,175**
Northern	Gill Ranch Gas	"Gill" 38-18	039-00039	850	10/26/2012	$33,000	$50,000	**$83,000**
Northern	Gill Ranch Gas	"Edison Securities" 25-20	039-00041	4433	10/15/2012	$25,000	$50,000	**$75,000**
Northern	Gill Ranch Gas	"Gill" 47X18	039-20001	823	9/13/2012	$27,000	$50,000	**$77,000**
Northern	Gill Ranch Gas	19X	039-20007	3770	11/7/2012	$27,000	$50,729	**$77,729**
Southern	Brea-Olinda	"Stearns" 17	059-06960	1261	7/22/2013	$167,000	$83,322	**$250,322**
Southern	Long Beach	Goedhart 2	065-20011	6255	8/10/2018	$141,237		**$141,237**
Northern	River Island Gas	"River Islands Land Co." 6	067-20065	3795	7/13/2016	$44,900	$51,577	**$96,477**
Northern	River Island Gas	"Jim Graham" 1-15	067-20321	8450	7/8/2016	$58,300		**$58,300**
Coastal	Hollister	"Balsa" 1	069-00038	3145	10/30/2019	$81,759		**$81,759**
Coastal	Hollister	"Cabrillo" 1	069-00039	3855	6/19/2019	$92,288	$43,074	**$135,362**

Region	Field	Well Name	API #	Well Depth	P&A Date	Original Cost	T&M Cost	Total Cost
Coastal	Hollister	"Felipe" 2	069-00043	3031	7/17/2018	$60,758		**$60,758**
Coastal	Hollister	"Flint" 1	069-00047	2425	5/16/2019	$87,708		**$87,708**
Coastal	Hollister	"Red Cloud" 1	069-20055	6906	10/28/2018	$145,608	$68,895	**$214,503**
Northern	French Camp Gas	"Reynolds and Carver West" (DG) 1	077-20003	8650	4/20/2020	$241,574		**$241,574**
Northern	French Camp Gas	"Reynolds and Carver-Long" (WD) 1	077-20033	5700	3/10/2020	$289,436	$192,670	**$482,106**
Northern	River Island Gas	"Gianelli" 1	077-20100	8656	7/13/2020	$128,026	$11,022	**$139,048**
Northern	San Joaquin County	"Jackson et al" 1	077-20630	6658	7/21/2020	$152,914	$32,156	**$185,070**
Northern	East Islands Gas	"Morais" 16-2	077-20737	4923	5/12/2020	$115,059		**$115,059**
Northern	Oil Creek	"Costa" 1	081-00081	2206	10/1/2019	$181,407		**$181,407**
Northern	Oil Creek	"Costa" 5	081-20007	2679	10/8/2019	$133,967		**$133,967**
Northern	Oil Creek	"Costa" 7-A	081-20020	2085	10/9/2019	$171,080		**$171,080**
Coastal	Mesa	Gaviota Oil Company 1	083-03657	1957	12/2/2013	$164,464	$455,011	**$619,475**
Coastal	Any Field	Carpinteria Community" 1	083-04313	1382	5/16/2012	$38,770		**$38,770**
Northern	Maine Prairie Gas	"WZU" 13	095-20356	4766	6/28/2016	$52,000		**$52,000**
Northern	Lindsey Slough	"A.H.C. Church" 11	095-20708	10716	6/27/2018	$124,055	$171,388	**$295,443**
Northern	Maine Prairie Gas	"WZU" 15	095-20804	4670	6/22/2016	$46,000		**$46,000**
Northern	Lindsey Slough Gas	"North Willows Springs" 1-2	095-20897	10520	8/12/2016	$57,300	$10,000	**$67,300**
Northern	Lindsey Slough Gas	"North Willows Springs" 2-2	095-20932	10890	8/2/2016	$77,000	$7,164	**$84,164**
Northern	Maine Prairie Gas	"H&T" 1-2	095-21017	5738	6/18/2016	$49,000	$5,400	**$54,400**
Northern	Maine Prairie Gas	"CMI Zannetti" 9	095-21265	5329	7/1/2016	$50,940		**$50,940**
Northern	Maine Prairie	"CMI Zanetti" 10	095-21273	5660	3/13/2018	$55,018		**$55,018**
Northern	Maine Prairie	"CMI" 6-14	095-21298	2150	8/29/2018	$42,940		**$42,940**
Central	Trico Gas	"Tidewater Associated Fee" 2	107-00063	2435	7/21/2016	$22,878	$48,600	**$71,478**
Central	Trico Gas	"Tidewater Associated Fee" 3	107-00064	2510	7/21/2016	$21,451	$48,600	**$70,051**
Central	Trico Gas	"Lee Community" 1	107-00065	2905	8/12/2015	$41,310	$11,308	**$52,618**
Central	Trico Gas	"Lee Community" 3	107-00067	2545	8/14/2015	$32,760	$11,308	**$44,068**
Central	Trico Gas	"Newland" 4	107-00081	2458	11/18/2014	$35,118		**$35,118**
Central	Trico Gas	"Newland" 5	107-00100	2516	11/25/2014	$33,718		**$33,718**
Central	Trico Gas	"Newland" 7	107-20003	2472	11/17/2014	$27,315		**$27,315**
Central	Trico Gas	"Newland" 9	107-20027	2456	1/2/2015	$27,299		**$27,299**
Central	Trico Gas	"Trico Newland" 12	107-20060	2348	11/20/2014	$32,771		**$32,771**

Region	Field	Well Name	API #	Well Depth	P&A Date	Original Cost	T&M Cost	Total Cost
Central	Trico Gas	"Bryson" 7	107-20171	1625	12/1/2014	$28,165		**$28,165**
Central	Trico Gas	"Vinita Kay" 1-17	107-20236	2376	8/6/2015	$34,179		**$34,179**
Central	Trico Gas	"Guy" 1	107-20240	2712	7/13/2016	$19,140	$32,532	**$51,672**
Coastal	Simi	"Patterson Ranch" 1	111-00125	539	4/27/2014	$30,000		**$30,000**
Coastal	Simi	"Patterson Ranch" 2	111-00126	650	4/28/2014	$30,000		**$30,000**
Coastal	Simi	"Water Company" 1	111-03079	442	4/29/2014	$30,000		**$30,000**
Coastal	South Mountain	"Richardson Ranch" 1	111-03198	2991	5/16/2012	$35,667		**$35,667**
Northern	Putah Sink Gas	"Shoshone-Cowell" 1	113-20175	6878	6/15/2020	$186,114	$2,000	**$188,114**
Northern	Putah Sink Gas	"Shoshone-Cowell" 2-34	113-20215	6963	5/19/2020	$189,576	$6,363	**$195,939**
Northern	Putah Sink Gas	"Shoshone-Cowell" 3-34	113-20237	6831	5/29/2020	$197,572		**$197,572**

Well P&A Cost Estimate Study by Independent Contractor

LOCATION	OPERATOR	# OF WELLS	ESTIMATED	COST BY	WELL TYPE
(COUNTY)		Reviewed	Simple	Semi - Complex	Complex
VENTURA	Operator 1	14	$54,744	$82,533	$122,628
VENTURA	Operator 2	55	$39,668	$60,254	$98,170
KERN	Operator 3 (Field 1)	38	$78,476	$115,413	$156,952
	Operator 3 (Field 2)	4	$104,821	$130,302	$209,643
KERN / KINGS	Operator 4 (Field 1)	27	$75,779	$130,097	$169,747
	Operator 4 (Field 2)	42	$31,533	$50,446	$70,635
	Operator 4 (Field 3)	24	$34,428	$64,844	$96,400
	Operator 4 (Field 4)	9	$31,778	$63,509	$88,979
LOS ANGELES	Operator 5	24	$73,401	$110,992	$183,504
LOS ANGELES	Operator 6	14	$107,497	$141,952	$214,995
LOS ANGELES	Operator 7	15	$145,051	$156,649	$304,607
LOS ANGELES	Operator 8	6	$82,462	$113,477	$189,664
TEHAMA	Operator 9	25	$67,571	$99,067	$162,171
SANTA BARBARA	Operator 10	27	$96,741	$163,855	$232,179
LOS ANGELES	Operator 11	214	$71,378	$109,542	$192,722

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Agreement Number	Term Dates
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2011-008	6/28/2012 - 6/28/2013
2011-011	6/5/2012 - 6/5/2013
2012-004	3/25/2013 - 3/5/2014
2012-005	3/25/2013 - 3/5/2014
2012-007	5/24/2013 - 5/24/2014
2012-008	5/24/2013 - 5/24/2014
2012-010	6/18/2013 - 6/18/2014
2013-001	7/1/2014 - 12/1/2015
2013-006	7/1/2014 - 2/28/2015
2013-008	7/1/2014 - 10/31/2015
2014-002	10/20/2014 - 10/20/2016
2014-003	10/1/2014 - 2/26/2016
2014-016	5/18/2015 - 5/31/2016
2014-017	6/1/2015 - 5/31/2016
2015-030	6/23/2016 - 9/29/2016
2015-031	6/1/2016 - 9/30/2016
2015-033	6/1/2016 - 9/30/2016
2017-001	7/1/2017 - 12/31/2018
2017-002	10/5/2017 - 11/16/2018
2017-016	6/20/2018 - 5/25/2020
2017-019	6/20/2018 - 12/31/2019
2017-020	6/20/2018 - 5/25/2019
2018-020	6/3/2019 - 6/30/2020
2018-027	6/3/2019 - 6/30/2020
2019-001	8/19/2019 - 10/23/2019
2019-002	9/16/2019 - 6/30/2020
2019-003	9/16/2019 - 6/30/2020
2019-004	9/16/2019 - 6/30/2020
2019-008	9/30/2019 - 9/30/2020
2019-009	8/19/2019 - 10/23/2019
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