TETRA TECH EC, INC.

California Energy Commission
DOCKETED
11-AFC-3
TN # 68296
OCT 31 2012

October 31, 2012

Mr. Eric Solorio
California Energy Commission
Docket No. 11-AFC-3
1516 9th St.
Sacramento, CA 95814

Cogentrix Quail Brush Generation Project - Docket Number 11-AFC-3, Quail Brush Generation Project Revised CALPUFF Nitrogen Deposition Rates

Docket Clerk:

Pursuant to the provisions of Title 20, California Code of Regulation, and on behalf of Quail Brush Genco, LLC, a wholly owned subsidiary of Cogentrix Energy, LLC, Tetra Tech hereby submits the *Revised CALPUFF Nitrogen Deposition Rates* for the Quail Brush Power Project (11-AFC-3). Please note that the revised CALPUFF input and output data files will be provided directly to the air quality specialist at the CEC. Should others require these files, they may request them from Tetra Tech. The Quail Brush Generation Project is a 100 megawatt natural gas fired electric generation peaking facility to be located in the City of San Diego, California. The issue area addressed in this submittal is:

- Air Quality

If you have any questions regarding this submittal, please contact Rick Neff at (704) 525-3800 or me at (303) 980-3653.

Sincerely,

Constance C. Farmer

Constance E. Farmer
Project Manager/Tetra Tech

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
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APPLICATION FOR CERTIFICATION FOR THE QUAIL BRUSH GENERATION PROJECT

DOCKET NO. 11-AFC-03
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(Revised 10/29/2012)

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DECLARATION OF SERVICE

I, Constance Farmer, declare that on October 31, 2012, I served and filed copies of the attached Revised CALPUFF Nitrogen Deposition Rates, dated October 31, 2012. This document is accompanied by the most recent Proof of Service list, located on the web page for this project at: http://www.energy.ca.gov/sitingcases/quailbrush/index.html.

The document has been sent to the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit or Chief Counsel, as appropriate, in the following manner:

(*Check all that Apply*)

For service to all other parties:

_x_ Served electronically to all e-mail addresses on the Proof of Service list;

___ Served by delivering on this date, either personally, or for mailing with the U.S. Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses marked *"**hard copy required**" or where no e-mail address is provided.

AND

For filing with the Docket Unit at the Energy Commission:

_x_ by sending an electronic copy to the e-mail address below (preferred method); *OR*

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OR, if filing a Petition for Reconsideration of Decision or Order pursuant to Title 20, § 1720:

___ Served by delivering on this date one electronic copy by e-mail, and an original paper copy to the Chief Counsel at the following address, either personally, or for mailing with the U.S. Postal Service with first class postage thereon fully prepaid:

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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Constance C. Farmer

Nitrogen Deposition Rates

Chemical Transformation of NO_x Emissions

The oxidation of nitrogen oxides is a complicated process that can include a large variety of nitrogen species, such as nitrogen dioxide (NO_2), nitric acid (HNO_3) and organic nitrates (RNO_3) such as peroxyacetylnitrate (PAN). Atmospheric chemical reactions that occur in sunlight result in the formation of ozone and other compounds. Depending on atmospheric conditions, these reactions can start to occur within several hundred meters of the original NO_X source, or after the pollutants have been carried tens of kilometers downwind. Ultimately, some nitrogen oxides are converted to nitric acid vapor or particulate nitrates. Precipitation is one mechanism that removes these pollutants from the air. Forms of atmospherically derived nitrogen are removed from the atmosphere by both wet deposition (rain) and dry deposition (direct uptake by vegetation and surfaces).

Ammonia and ammonium are other forms in which nitrogen occurs. Ammonia is a gas that becomes ammonium when dissolved in water, or when present in soils or airborne particles. Unlike NO_X, which forms during combustion, soil microorganisms naturally form ammonia and ammonium compounds of nitrogen and hydrogen.

In urban atmospheres, the oxidation rate of NO_X to HNO_3 is estimated to be approximately 20 percent per hour, with a range of 10 to 30 percent per hour (CARB, 1986). Aerosol nitrates (NO_3) are present, mainly in the form of ammonium nitrate (NH_4NO_3). Nitrate and ammonium (NH_4) are the predominant forms by which plants absorb nitrogen. In California, ammonium nitrate is the predominant airborne nitrate-bearing particle in the atmosphere (CARB, 1986).

To assess the potential for nitrogen deposition, both AERMOD and CALPUFF were used. While both models contain deposition algorithms, the treatment of the complex chemistry that transforms NO_x emissions into nitrogen are handled very differently between the two models. As discussed below, no chemistry was used in the AERMOD analysis. Instead, all emissions of NO_x and ammonia were assumed to instantaneously form depositional nitrogen in stack, thus being immediately available for deposition. CALPUFF, by comparison, contains the MESOPUFF II chemical scheme which has been widely used to assess the conversion of the various species of NO_x into nitrogen. Thus, the assumption used in AERMOD was not used in the CALPUFF modeling analysis. The description of the CALPUFF model, along with the input data used in the modeling analysis, is presented below. The AERMOD results were presented previously.

Description of the CALPUFF Model

The use of a single plume, steady state Gaussian model (AERMOD) to represent the complex formation of nitrogen in complex terrain can produce conservatively unrealistic results. Traditional Gaussian models cannot take into account the complex dispersion and deposition conditions that can arise over modeling domains in complex terrain.

As part of an Interagency Workgroup on Air Quality Modeling (IWAQM) study to design and develop a generalized non-steady-state air quality modeling system for regulatory use in situations where long range transport is involved, the CALPUFF dispersion model was developed. The original design specifications for the modeling system included: (1) the capability to treat time-varying point and area sources, (2) suitability for modeling domains from tens of meters to hundreds of kilometers from a source, (3) concentrations for averaging times ranging from one-hour to one year, (4) applicability to inert pollutants and those subject to linear removal and chemical conversion mechanisms, and, (5) applicability for rough or complex terrain situations.

The modeling system developed to meet these objectives consisted of three components: (1) a meteorological modeling package with both diagnostic and prognostic wind field generators, (2) a Gaussian puff dispersion model with chemical removal, wet and dry deposition, complex terrain algorithms, building downwash, plume fumigation, and other effects, and (3) post-processing programs for the output fields of meteorological data, concentrations and deposition fluxes.

CALPUFF is a multi-layer, multi-species, multi-source, non-steady-state puff dispersion model which can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF can use the three dimensional meteorological fields developed by the CALMET model, or simple, single station winds in a format consistent with the meteorological files used to drive the AERMOD steady-state Gaussian model. For this analysis, the single-station meteorological data set was used.

CALPUFF Modeling Assumptions

A screening mode of the CALPUFF modeling system was run for the proposed project in order to calculate potential impacts the areas surrounding the project location. This modeling analysis focused on the potential nitrogen depositional impacts to protected areas in the vicinity of the project. The modeling followed screening guidance as provided by the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report. The modeling procedures also incorporate comments provided by the Federal Land Managers' Air Quality Related Values workgroup (FLAG) Final Phase I report (December 2000).

The assumption used in the AERMOD modeling analysis where all emissions of NO_x and ammonia were converted in-stack into depositional nitrogen was not used in the CALPUFF modeling analysis. Unlike AERMOD, CALPUFF incorporates a chemical algorithm which calculates the atmospheric transformation of NO_x (and its associated species) along with ammonia into depositional nitrogen. The chemical scheme used in CALPUFF was the MESOPUFF II algorithm, as recommended by the IWAQM Phase 2 Summary Report.

The screening mode of the CALPUFF modeling system requires hourly, single-station meteorological data as input, both surface and upper air. Based on the guidance contained in the IWAQM Phase 2 Summary Report, CALPUFF was used in a screening mode, which required five years of single station meteorology. Five years of surface data were obtained for San Diego Lindberg Field Airport (1986-1990) from the National Climatic Data Center. The upper air data was collected for the same time period from the Miramar Naval Air Station.

The PCRAMMET meteorological preprocessor, as recommended by the IWAQM Phase 2 Report, was used to process the surface, precipitation, and upper air data. PCRAMMET requires complete data sets of the following variables: wind speed, wind direction, temperature, ceiling height, opaque cloud cover or total cloud cover, surface pressure, relative humidity, and precipitation type. The five years of upper air data includes twice-daily mixing heights. PCRAMMET was run with wet deposition options as required in the Phase 2 Report. Five years of data was preprocessed with PCRAMMET, which was then used as input into CALPUFF.

CALPUFF also requires domain averaged background ozone (O_3) and ammonia (NH_3) concentrations for the Mesopuff II chemistry algorithm. For O_3, a domain-averaged value of 29 ppb was used. For NH_3, a domain average value of 10 ppb was selected and was based on results of using the AERMOD model to calculate background NH_3 from the proposed project.

A CALPUFF control file was generated that included IWAQM recommended defaults for the model options. This included rural dispersion coefficients, default wind speed profile exponents, and default vertical potential temperature gradient. Given the close proximity of the receptors to the source, the slug option was selected to represent a plume as a solid slug of material rather than a series of individual puffs as the transport time to many of the receptors would be sub-hourly. Model options are listed in the CALPUFF model output, which is included on compact disk. A brief summary of the options used in the modeling analysis are listed below:

- Number of X grid cells = 2
- Number of Y grid cells = 2
- Number of vertical layers = 1
- Grid spacing = 83 km
- Cell face heights = 5000 meters
- Minimum mixing height = 50 meters
- Maximum mixing height = 5000 meters (based on observational data)
- Minimum wind speed allowed for non-calm conditions = 0.5 m/s
- Vertical distribution used in the near field = gaussian
- Terrain adjustment method = partial plume path adjustment
- No puff splitting allowed
- Chemical mechanism = Mesopuff II
- Wet and dry removal modeled
- Dispersion coefficients = PG dispersion coefficients
- PG sigma-y and z not adjusted for roughness
- Partial plume penetration of elevated inversion allowed
- Lateral turbulence not used

The computational grid extended 50 kilometers beyond the furthest receptor point.

Nitrogen Deposition Mechanisms

The deposition flux, F_d, is calculated as the product of the concentration, χ_d, and a deposition velocity, v_d, computed at a reference height z_d:

$$F_d = \chi_d \bullet v_d$$

The dry deposition algorithm is based on an approach that expresses the deposition velocity as the inverse sum of total resistance. The resistance represents the opposition to transporting the pollutant through the atmosphere to the surface. CALPUFF incorporates several resistance models that include aerodynamic resistance, canopy resistance, cuticle resistance, deposition layer resistance, mesophyll resistance, and stomatal action.

With wet deposition, gaseous pollutants are scavenged by dissolution into cloud droplets and precipitation. A scavenging ratio approach was used to model the deposition of gases through wet removal. In this approach, the flux of material to the surface through wet deposition (Fw) is the product of a scavenging ratio times the concentration, integrated in the vertical direction. Because the precipitation is assumed to initiate above the plume height, a wet deposition flux is calculated, even if the plume height exceeds the mixing height.

The modeling domain was assigned a unique vegetative and land use type for modeling nitrogen deposition. So the use characteristics were based on rangeland the surface roughness length, leaf-area index, and plant-growth state. For roughness lengths, domain-averaged values for rangeland for both an active growing season and an inactive season were identified. Leaf area indices were also based on domain-averaged values for an active growing season and an inactive/dormant season. To calculate nitrogen deposition velocities, the state of the vegetation must also be specified and included both active and stressed active an unstressed.

This approach was used to develop conservative, worst-case scenarios to evaluate potential nitrogen deposition.

Nitrogen Deposition Modeling Results

Results of the wet and dry nitrogen deposition modeling were summed to produce annual deposition rates in units of kilograms per hectare per year (kg/ha-yr). As the areas modeled cover a wide variety of elevations and distances, the deposition rate calculated for each receptor was averaged over the entire area(s).

Table 1 presents the worst-case CALPUFF modeled potential averaged annual deposition rates resulting from operation of the proposed project. Potential deposition rates throughout the area are extremely small (see Table 1). Figure 1 displays the deposition contours for the modeling domain. The depositional impacts from CALPUFF are approximately one to two orders of magnitude less than the AERMOD results.

TABLE 1
Modeled Annual Nitrogen Deposition
Impact Analysis for all species of NO_x Emissions Using MESOPUFF II in CALPUFF

Location	**Averaged Modeled Deposition from QBPP Over The Entire Modeling Area**			**Maximum Deposition Rate (kg/ha-yr)**
	Number of Receptors	*Landuse*	*Mean Annual*	*Maximum Annual*
CALPUFF			(kg/ha-yr)	(kg/ha-yr)
Regional Area	9,312	Rangeland	0.0152	0.0982

References Cited

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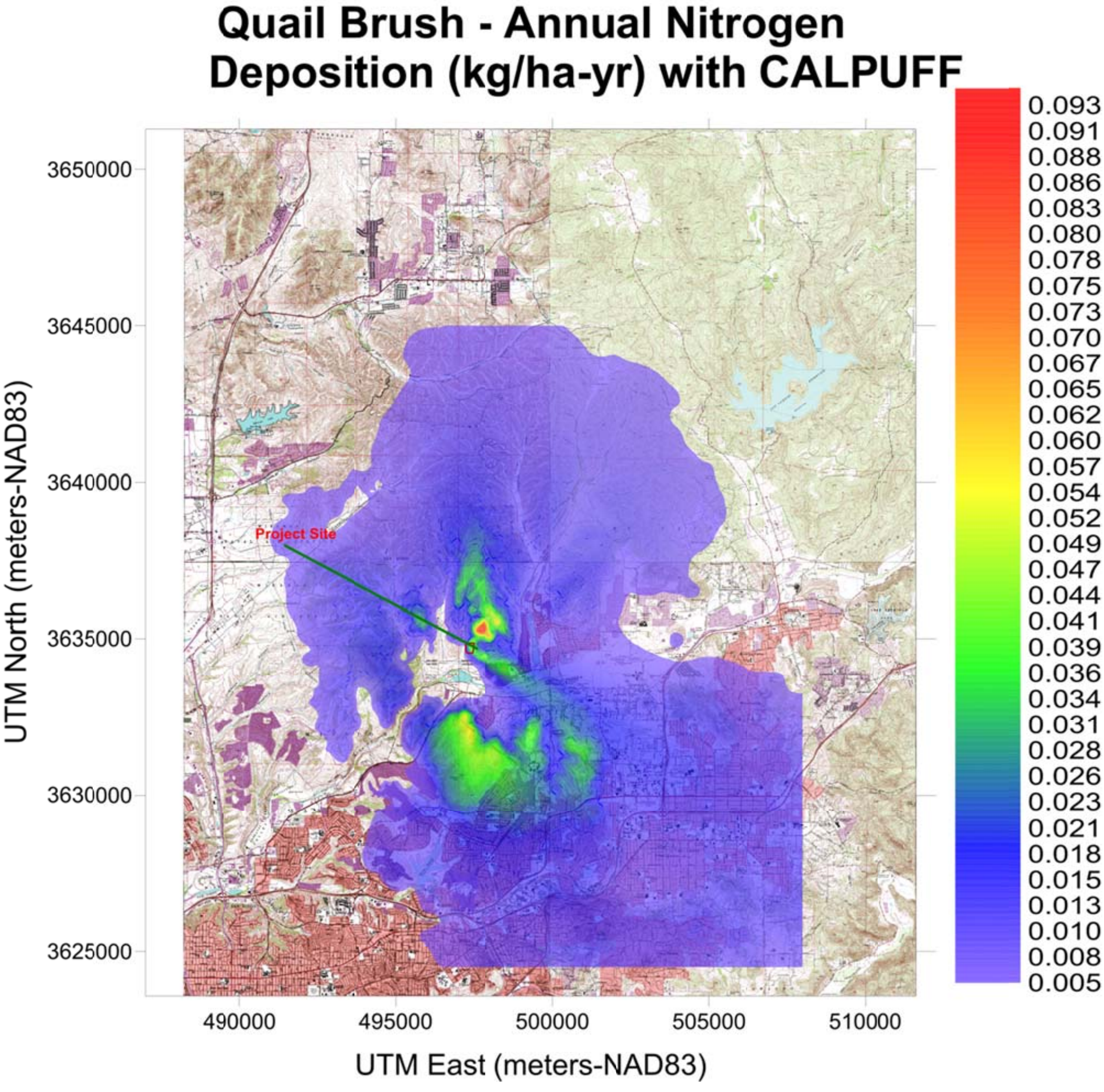
Figure 1


Quail Brush - Annual Nitrogen Deposition (kg/ha-yr) with CALPUFF
3650000
3645000
3640000
3635000
3630000
3625000
UTM North (meters-NAD83)
490000
495000
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UTM East (meters-NAD83)
Project Site
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