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**Engineering Evaluation
Stratus Environmental, Inc.
Plant No. 20643
Application No. 23085**

Stratus Environmental, Inc. has applied for an authority to construct and permit to operate the following equipment located at **967 H Street, Union City, CA 94587**.

- S-1 Soil Vapor Extraction and Air Sparge Remediation System, Roots Rotary Lobe Blower, 10 hp, 250 scfm abated by**

- A-1 SVE Abatement System consisting of Thermal/Catalytic Oxidizer, Solleco 250 TCAT, 400,000 Btu/hr, or a Carbon Adsorption System, consisting of a minimum of two-200 lb-vessels containing granular activated carbon connected in series.**

Background

The site is occupied by Escutia's Auto Repair Facility. The Alameda County Water District (ACWD) required remediation of groundwater impact at this site to mitigate subsurface petroleum hydrocarbon. Two 4,000-gallon single-walled underground storage tanks for leaded and unleaded gasoline were reported removed from the site on March 25, 1993. Soil samples taken during storage tank removal showed petroleum hydrocarbons in the subsurface. Impacted soil was over-excavated beneath the tanks and product piping. A total of approximately 200 cubic yards of excavated soil was removed to a class III landfill. Eight monitoring wells MW-1 through MW-8 were installed in 1994-1995. In July 2002, two soil vapor extraction wells and two air sparge wells were installed.

The *Revised Remedial Action Plan and Feasibility Study*, dated November 17, 2007, and subsequent Addendums, developed by prior consultant ACC Environmental Consultants, recommended both air sparging and soil vapor extraction to remove residual petroleum hydrocarbons from both the groundwater and the vadose zone soil. (Vadose zone soil extends from the top of the ground surface to the groundwater.)

Soil vapor samples were obtained on August 23, 2002, by Terra Vac, a previous consultant. The tests were conducted during the SVE and SVE-AS pilot test using wells VW-1, VW-2, SP-1 and SP-2. The highest concentration of total petroleum hydrocarbons as gasoline (TPHg) reported in the influent air sample from the test well

VW-1 was at 8.35 mg/m³ or 8,350 µg/L. The highest concentration of benzene was reported in the influent for well SP-1 at 0.20 mg/m³ or 20 µg/L. The following maximum concentrations reported from the pilot test of the soil vapor extraction wells and sparge wells for other BTEX compounds were as follows: Ethyl Benzene 390 µg/L, Toluene 670 µg/L, Xylene 3,720 µg/L.

The project will include a 250 cfm blower exhausting the vapor through an air/water separator to a thermal/catalytic oxidizer. Vapor condensate will be collected in a liquid/vapor separator tank with a 100 gallon capacity. This separator tank has a capacity of less than 260 gallons and is exempt from permit requirements according to Regulation 2-1-123.1.

The process includes both air sparging and soil vapor extraction to remove residual product from both the groundwater and soil. Air sparging is intended to volatilize lower weight petroleum hydrocarbons and to provide oxygen for enhanced biological degradation. A 10 hp rated oil-less compressor will be used for air sparging at wells AS-1, AS-2, AS-3 and AS-4.

The permit conditions for the SVE abatement system will include the option to switch from thermal/catalytic oxidation to carbon adsorption as needed. The applicant will be conditioned to provide written notification at the start of either abatement system.

The thermal/ catalytic oxidizer will be required to achieve a minimum abatement efficiency of 98.5% for inlet POC concentrations equal or above 2000 ppmv. A minimum operating temperature of 1400 degrees Fahrenheit must be maintained when operating as a thermal oxidizer. A minimum operating temperature of 600 degrees Fahrenheit must be maintained when operating as a catalytic unit. The oxidizer unit must be equipped with continuous measuring and temperature recording instrumentation. If carbon adsorption is used, the carbon unit influent and effluent VOC concentrations will be monitored with a portable photo-ionization detector (PID), flame-ionization detector (FID), or other approved method on a schedule reflecting current loading rates and predicted carbon capacity. To ensure proper operation of equipment and to verify attainment of steady-state conditions, carbon performance will be monitored weekly for the initial period. The owner/operator may then elect to change their monitoring schedule based on measured influent concentrations and calculated carbon loading. Monitoring schedule changes will be allowed only after District review of concentration measurements and subsequent receipt of District approval.

This source is located within 1000 feet of a school: **Purple Lotus Buddhist School, 33615 Ninth Street, Union City, CA 94587**; therefore, this application requires Public Notification per Reg. 2-1-412. Also, **James Logan High School, located at 1800 H Street, Union City, CA 94587** is within one-quarter mile of the source and will be included in Public Notification.

Emission Calculations:

S-1 Soil Vapor Extraction System

For a conservative estimate of yearly emissions, assume that the system is operated for an entire year with an inlet concentration corresponding to the soil concentration level as demonstrated by the most recent vapor sample levels conducted by Terra Vac. Generalized assumptions follow:

Operating conditions: Pressure = 1 Atm; Inlet Temperature 21° C
 1 mole occupies 24.15L

Molecular Weight of Total Petroleum Hydrocarbons = 100 g/mole.

Influent values based on operational parameters of equipment and applicant supplied soil vapor test results: influent rate 250 cfm,

Destruction efficiency of Carbon Adsorption or electric Catalytic Oxidation equals at least 98.5%

Emissions of Toxic Air Contaminants: The following emission calculations are based on laboratory test data from the permit application, summarized in Table 1 below.

e.g. Benzene - vapor sample showed 0.02 mg/L
 $0.02 \text{ mg/L} (\text{gm}/1\text{E}03 \text{ mg})(1\text{lb}/453.6 \text{ gm})(28.317 \text{ L}/\text{ft}^3) = 1.25\text{E}-6 \text{ lb}/\text{ft}^3$
 $1.25\text{E}-6 \text{ lb}/\text{ft}^3 (250 \text{ ft}^3/\text{min}) (1440 \text{ min}/\text{day})(365 \text{ days}/\text{yr}) (1-0.985) = 2.46 \text{ lb}/\text{yr abated}$
 $6.74\text{E}-3 \text{ lbs}/\text{day abated}$

Reg 2-5-1 Chronic Trigger level for Benzene = 3.8 lb/year

Table 1 Toxic and POC Emissions

	mg/L	ft3/min	lb/gm	g/mg	min/day	L/ft ³	lb/day	lb/day	lb/yr	lb/yr abated	Trigger
	RL							98.5%	unabated	98.5%	Level lbs/yr
Benzene	0.02	250	2.20E-03	1.00E-03	1440	28.317	4.49E-01	6.74E-03	1.64E+02	2.46E+00	3.8
Toluene	0.67	250	2.20E-03	1.00E-03	1440	28.317	1.51E+01	2.26E-01	5.50E+03	8.24E+01	1.20E+04
Total xylenes	3.72	250	2.20E-03	1.00E-03	1440	28.317	8.36E+01	1.25E+00	3.05E+04	4.58E+02	2.70E+04
Ethylbenzene	0.39	250	2.20E-03	1.00E-03	1440	28.317	8.76E+00	1.31E-01	3.20E+03	4.80E+01	4.30E+01
TPH	8.35	250	2.20E-03	1.00E-03	1440	28.317	1.88E+02	2.81E+00	6.85E+04	1.03E+03	

		Acute 1-hr max Trigger Level	Emissions
	gm/sec	lb/hr	lb/hr
Benzene	3.54E-05	2.90E+00	2.81E-04
Toluene	1.19E-03	8.20E+01	9.41E-03
Total xylenes	6.58E-03	4.90E+01	5.23E-02
Ethylbenzene	6.90E-04	N/A	5.48E-03
TPH	1.48E-02		

Total Potential VOC Emissions

The highest sample concentration levels from one well are as follows:

e.g. TPH - Gasoline Range Organics C4-C12 = 8.35 mg/L

$8.35 \text{ mg/L (gm/1E03 mg)(1lb/453.6 gm)(28.317 L/ft}^3) = 5.21\text{E-4 lb/ ft}^3$

$5.21\text{E-4 lb/ ft}^3 (250 \text{ ft}^3/\text{min}) (1440 \text{ min/day})(365 \text{ days/yr}) (1-0.985) = 1.03\text{E+3 lb/yr abated}$

2.81 lbs/day abated

A concentration of 8.35 mg/L is equivalent to 2017 ppmv.

Secondary emissions:

From Permit Handbook:

RACT for thermal and catalytic oxidizers have been established as:

NO_x = 0.2 lb/MMBTU

CO = 0.8 lb/MMBTU

Emission factors from AP-42, Table 1.4-2 (Natural Gas Combustion)

PM₁₀ = 0.075 lb/MMBTU

SO₂ = 0.0006 lb/MMBTU

POC = 0.0054 lb/MMBTU

With these emission factors, the annual emissions from the thermal/catalytic oxidizer can be calculated using the following equation:

$$Es = F \times B \times H$$

Where:

Es = Annual emissions of Abatement Device (lbs/yr)

F = Emission Factor of Criteria Pollutant (lb/MMBTU)

B = Maximum Firing Rate of Burner in Abatement Device (MMBTU/hr)

H = Maximum Number of Hours The Oxidizer will operate
(ie 24 hr/day x 365 day/yr = 8760 hrs/yr)

Pollutant	F	B	H	Es	tons/yr	lb/day
	lb/MMBTU	MMBTU	hrs	lb/yr F x B x H		
NOx	0.2	0.5	8760	876	0.438	2.4
CO	0.8	0.5	8760	3504	1.752	9.6
PM10	0.75	0.5	8760	3285	1.6425	9
SO2	0.0006	0.5	8760	2.628	0.001314	0.0072
POC	0.0054	0.5	8760	23.652	0.011826	0.0648

There are no secondary emissions for the operation of a carbon adsorption system.

Toxic Risk Screening Analysis

The emissions of ethylbenzene listed above exceeds the trigger levels listed in Regulation 2, Rule 5, Table 2-5-1. Therefore, a risk screening analysis was performed. Results from the health risk screening analysis of the proposed project indicate that the maximum cancer risk is estimated at 0.72 chances in a million. The resulting maximum chronic hazard index is 0.0021. In accordance with the District's Regulation 2-5, this risk level is considered acceptable, since the cancer risk is within the threshold of 10 in a million as required for sources implementing TBACT.

Estimates of residential risk assume potential exposure to annual average TAC concentrations occur 24 hours per day, 350 days per year, for a 70-year lifetime. Risk estimates for offsite workers assume potential exposure occurs 8 hours per day, 245 days per year, for 40 years. Risk estimates for students assume a higher breathing rate, and potential exposure is assumed to occur 10 hours per day, 36 weeks per year, for 9 years. Cancer risk adjustment factors (CRAFs) were used to calculate all cancer risk estimates.

The estimated health risks for this permit application are presented in the table below.

Receptor	Cancer Risk	Chronic Hazard Index
Resident	0.72 chances in a million	2.1E-03
Worker	0.08 chances in a million	4.9E-04
Student	0.01 chances in a million	3.4E-05

New Source Review

This proposed project unabated has the potential to emit over 10 lbs per highest day. For Soil Vapor Extraction operations, BACT is defined as attainment of set destruction efficiencies corresponding to set influent concentration values as follows:

***BAY AREA AIR QUALITY MANAGEMENT DISTRICT
Best Available Control Technology (BACT) Guideline***

Source Category

Source:	<i>Soil Vapor Extraction</i>	Revision:	<i>3</i>
		Document #:	<i>151A.1</i>
Class:	<i>All</i>	Date:	<i>06/16/95</i>

Determination

POLLUTANT	BACT 1. Technologically Feasible/ Cost Effective 2. Achieved in Practice	TYPICAL TECHNOLOGY
POC	1. ≤ 10 ppmv at outlet of control device; or $\geq 98.5\%$	1. Two or More Activated Carbon Canister in Series or Thermal

	<p><i>capture/destruction efficiency^{a,T}</i> 2. ≤ 10 ppmv at outlet of control device; or $\geq 98.5\%$ capture/destruction efficiency if inlet VOC ≥ 2000 ppmv; or $\geq 97\%$ capture/destruction efficiency if inlet VOC ≥ 200 to < 2000 ppmv; or $\geq 90\%$ capture/destruction efficiency if inlet VOC < 200 ppmv^{a,T}</p>	<p><i>Oxidizer^{a,T}</i> 2. Two or More Activated Carbon Canisters in Series or Thermal Oxidizer or Catalytic Oxidizer^{a,T}</p>
NO_x	<p>1. n/a 2. n/a</p>	<p>1. n/a 2. n/a</p>
SO₂	<p>1. n/a 2. n/a</p>	<p>1. n/a 2. n/a</p>
CO	<p>1. n/a 2. n/a</p>	<p>1. n/a 2. n/a</p>
PM₁₀	<p>1. n/a 2. n/a</p>	<p>1. n/a 2. n/a</p>
NPOC	<p>1. ≤ 10 ppmv at outlet of control device^{a,T} 2. ≤ 10 ppmv at outlet of control device; or $\geq 95\%$ capture/recovery efficiency^{a,T}</p>	<p>1. Two or More Activated Carbon Canisters in Series^{a,T} 2. Two or More Activated Carbon Canisters in Series^{a,T}</p>

References

<p>a. BAAQMD T. TBACT</p>
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Operation of a thermal oxidizer, catalytic oxidizer or carbon adsorption unit meet the criteria for TBACT for this source operation. Secondary emissions from operation of a thermal oxidizer/catalytic oxidizer is subject to RACT standards. Offsets are not required as annual emissions will not exceed 10 tons.

CEQA

The project is considered to be ministerial under the Districts proposed CEQA Regulation 2-1-311, and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and

standard emission factors, and therefore, is not discretionary as defined by CEQA. This project is in compliance with Chapters 9.2 of the permit handbook.

Compliance

District Rules and Regulations Applicable Requirements: Soil vapor extraction operations are subject to Regulation 8-47 (Air Stripping and Soil Vapor Extraction Operations). Based on the information submitted, this operation is expected to be in compliance with Regulation 8-47-301, Emission Control Requirement, Specific Compounds. The benzene and ethylbenzene emissions shall be vented at all times of operation to a thermal/catalytic oxidizer, or a carbon adsorption system, which will reduce emissions by at least 90 percent by weight.

The system includes a Liquid Separator tank, with a total capacity of 100 gallons. This separator tank has a capacity of less than 260 gallons and is therefore exempt from permit requirements according to Regulation 2-1-123.1.

Recommendation:

Recommend that a conditional Permit to Operate be issued for:

- S-1 Soil Vapor Extraction and Air Sparge Remediation System, Roots Rotary Lobe Blower, 10 hp, 250 cfm abated by
- A-1 SVE Abatement System consisting of Thermal/Catalytic Oxidizer, Solleco 250 TCAT, 400,000 Btu/hr, or a Carbon Adsorption System, consisting of a minimum of two-200 lb-vessels holding granular activated carbon connected in series.

Permit Conditions

Condition # 24907

1. The owner/operator shall abate the Precursor Organic Compound (POC) emissions from Source S-1 SVE Remediation System by A-1 SVE Abatement System, consisting of either a thermal/catalytic Oxidizer, Solleco 250 TCAT, or two (200 lbs minimum capacity) Activated Carbon Vessels arranged in series during all periods of operation. Start-up and subsequent operation of each abatement device shall take place only after written notification of same has been received by the District's Engineering

Division. The owner/operator shall operate the sources such that the soil vapor flow rate from S-1 shall not exceed 250 acfm. [basis: Cumulative Increase, Regulation. 8-47-301 and 302, TBACT]

2. The owner/operator shall operate A-1 Thermal/Catalytic Oxidizer such that the POC abatement efficiency shall be maintained at a minimum of 98.5% by weight for inlet POC concentrations greater than or equal to 2000 ppmv (measured as hexane). For inlet concentrations below 2000 ppmv and greater than or equal to 200 ppmv, a minimum abatement efficiency of 97% shall be maintained by the owner/operator. For inlet concentrations below 200 ppmv, a minimum abatement efficiency of 90% shall be maintained by the owner/operator. The minimum abatement efficiency shall be waived if outlet POC concentrations are shown to be less than 10 ppmv (measured as hexane). [basis: Cumulative Increase, Regulation 2-5, TBACT]
3. While operating as a Thermal Oxidizer, the owner/operator shall not operate A-1 below a minimum operating temperature of 1400 degrees Fahrenheit. While operating as a Catalytic Oxidizer, the owner/operator shall not operate A-1 below a minimum operating temperature of 600 degrees Fahrenheit. [basis: Cumulative Increase, Regulation 2-5, TBACT]
4. To determine compliance with Condition # 3, the owner/operator shall equip the A-1 Thermal/Catalytic Oxidizer with continuous measuring and temperature recording instrumentation. The owner/operator shall collect and maintain the temperature data from the temperature recorder in a file, which shall be available for District inspection for a period of at least 2 years following the date on which such data are recorded. [basis: Regulation 1-523]
5. The owner/operator of this source shall maintain the following records for each month of operation of the Thermal/Catalytic Oxidizer:
 - a. Days and hours of operation.
 - b. Each emission test, analysis or monitoring result logged in for the day of operation they were taken.
 - c. Total throughput of soil vapor from source S-1 in Standard Cubic Feet.Such records shall be retained and made available for inspection by the District for two years following the date the data is recorded. [basis: Regulation 1-523]
6. To determine compliance with Condition # 2, within ten days after start-up of the Thermal/Catalytic Oxidizer, the owner/operator of this source shall:
 - a. Analyze inlet gas stream to determine the flow rate and concentration of POC present.
 - b. Analyze exhaust gas to determine the flow rate, and the concentration of benzene, ethylbenzene, toluene and xylenes and POC present.
 - c. Calculate the benzene, ethylbenzene, toluene and xylene emission rates in pounds per day and the total organic emissions based on the exhaust gas analysis and the operating exhaust flow rate.
 - d. Calculate the POC abatement efficiency based on the inlet and exhaust gas analysis. For the purpose of determining compliance with Condition # 2, the owner/operator shall report the POC concentration as hexane.
 - e. Submit to the District's Engineering Division the test results and emission calculations within one month from the testing date. The owner/operator shall analyze samples according to modified EPA test methods 8015 and 8020 or their equivalent to determine the concentrations of POC and benzene. [basis: Cumulative Increase, Regulation 2-5, TBACT]
7. During operation of the A-1 Activated Carbon Vessels, the owner/operator of this source shall monitor with a photo-ionization detector (PID), flame-ionization detector (FID), or other method approved in writing by the District's Source Test Manager at the following locations:

- a. At the inlet to the second to last Carbon vessel in series.
- b. At the inlet to the last Carbon vessel in series.
- c. At the outlet of the Carbon vessel that is last in series prior to venting to the atmosphere.

When using an FID to monitor breakthrough, readings may be taken with and without a Carbon filter tip fitted on the FID probe. Concentrations measured with the Carbon filter tip in place shall be considered methane for the purpose of these permits conditions. [basis: Cumulative Increase, Regulation 2-5, TBACT]

8. The owner/operator shall record these monitor readings in a monitoring log at the time they are taken. The owner/operator shall use the monitoring results to estimate the frequency of carbon change-out necessary to maintain compliance with Condition Numbers 9 and 10, and shall be conducted on a daily basis. The owner/operator of this source may propose for District review, based on actual measurements taken at the site during operation of the source, that the monitoring schedule be changed based on the decline in organic emissions and/or the demonstrated breakthrough rates of the carbon vessels. Written approval by the District's Engineering Division must be received by the owner/operator prior to a change to the monitoring schedule. [basis: Cumulative Increase, Regulation 2-5, TBACT]
9. The owner/operator shall immediately change out the second to last Carbon vessel with unspent carbon upon breakthrough, defined as the detection at its outlet of the higher of the following:
 - a. 10 % of the inlet stream concentration to the carbon bed.
 - b. 10 ppmv (measured as hexane).[basis: Cumulative Increase, Regulation 2-5, TBACT]
10. The owner/operator shall immediately change out the last Carbon vessel with unspent Carbon upon detection at its outlet of 10 ppmv (measured as hexane). [basis: Cumulative Increase, Regulation 2-5, TBACT]
11. The owner/operator of this source shall maintain the following information for each month of operation of the Activated Carbon Vessels:
 - a. Hours and time of operation.
 - b. Each emission test, analysis or monitoring result logged in for the day of operation they were taken.
 - c. The number of Carbon vessels removed from service.
 - d. Total throughput of soil vapor from source S-1 in Standard Cubic Feet.

The owner/operator shall retain and make available for inspection by the District such records for two years following the date the data is recorded. [basis: Regulation 1-523]

12. The owner/operator shall report any non-compliance with these conditions to the Compliance and Enforcement Division at the time that it is first discovered. **The owner/operator shall detail the corrective action taken and include the data showing the exceedance as well as the time of occurrence in the submittal.** [basis: Cumulative Increase, Regulation 2-5, TBACT]

13. The owner/operator shall maintain a file containing all measurements, records and other data that are required to be collected pursuant to the various provisions of this conditional Authority to Construct/Permit to Operate. All measurements, records and data required to be maintained by the owner/operator shall be retained for at least two years following the date the data is recorded. [basis: Regulation 1-523]
14. Upon final completion of the remediation project, the owner/operator of Sources S-1 shall notify the Engineering Division within two weeks of decommissioning the operation. [basis: Cumulative Increase, Regulation 2-5, TBACT]

By _____ Date _____

Judith A. Cutino, PE
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