

**DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
Permit Application Analysis
A0001056**

September 4, 2015

NAME OF FIRM: Chesapeake Operating, LLC

MAILING ADDRESS: 414 Summers Street
Charleston, WV 25301

RESPONSIBLE OFFICIAL: Melissa Hatfield-Atkinson
Manager - Environmental

TELEPHONE NUMBER: (304) 353-5118

TYPE OF OPERATION: multiple well, sweet crude oil and natural gas production facility

FACILITY NAME: **Smith Creek 8-32-70 B PAD**

FACILITY LOCATION: NW¼ NW¼ of Section 8, T32N, R70W
Latitude: 42.76591° Longitude: -105.28269°
Converse County, Wyoming

DATE FACILITY BECAME OPERATIONAL: Pending, in process of drilling and completing wells

REVIEWER: Heather Bleile, Air Quality Engineer

PURPOSE OF APPLICATION: Chesapeake Operating filed this application construct a new multiple well sweet crude oil and natural gas production facility, known as the Smith Creek 8-32-70 B PAD, consisting of the Smith Creek 8-32-70 B SX 5H, B SX 7H and B SX 9H wells.

The Smith Creek 8-32-70 B PAD, consisting of the Smith Creek 8-32-70 B SX 5H, B SX 7H and B SX 9H wells are pending wells that are in the process of being completed or will be drilled in the future.

Production and equipment for the three wells are co-located and/or shared and all associated air emissions are aggregated for permitting determinations.

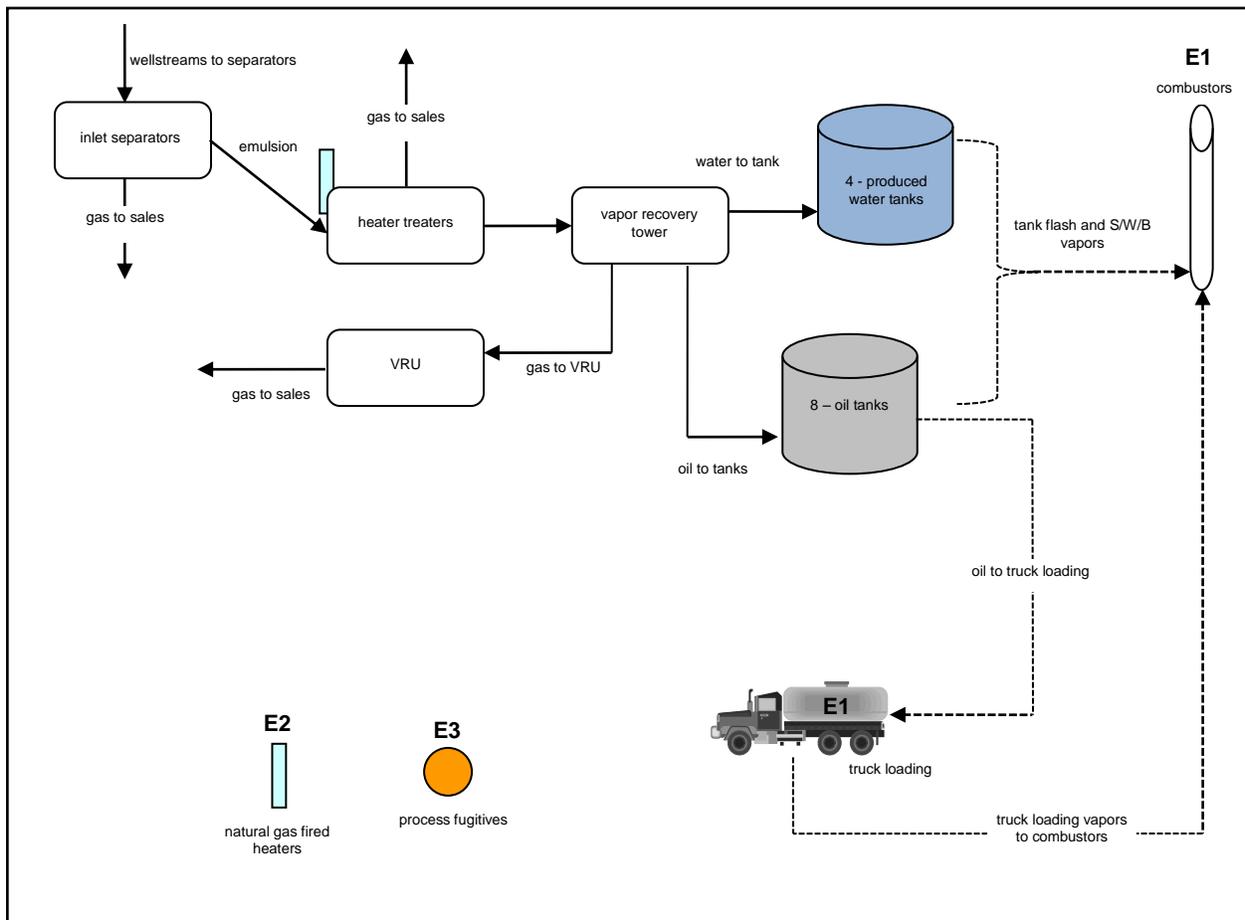
The following equipment operates at the Smith Creek 8-32-70 B PAD:

- three (3) unheated inlet separators
- three (3) heater treaters w/ 0.5 million Btu per hour (MMBtu/hr) heaters
- one (1) vapor recovery tower
- eight (8) 400-barrel (bbl) oil storage tanks
- four (4) 400-bbl produced water tanks
- one (1) electrically-driven vapor recovery unit (VRU)
- two (2) smokeless emergency flares (produced gas control during upset conditions)

Equipment list continued

- one (1) smokeless emergency air-assisted flare (vapor recovery tower flash emissions control during upset conditions)
- two (2) common smokeless combustion devices w/ continuous pilot monitoring systems (oil tank, active produced water tank and truck loadout emissions control)

PROCESS DESCRIPTION: The following is a simplified process schematic for this facility and is not intended to represent actual equipment placement. A complete process description is found in the permit application.



ESTIMATED EMISSIONS: (summarized in the attached tables)

oil storage tanks:

flashing losses:

Uncontrolled volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions were estimated using the Promax process simulator based on an average extended hydrocarbon analysis of pressurized oil from nearby wells and the daily oil production projected by the applicant.

standing/working/breathing (S/W/B) losses:

Uncontrolled VOC emissions are estimated using EPA Tanks 4.0 software.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) associated with flashing and S/W/B losses are based on the reported 98% destruction efficiency of the common combustion devices. Nitrogen oxide (NO_x) and carbon monoxide (CO) emissions are based on 0.14 lb NO_x/MMBtu and 0.035 lb CO/MMBtu and the volume of vapors calculated with the Promax simulator.

active produced water tanks: (Emission Source E1, Process Flow Diagram)

The Division is currently not requiring emission calculations for active produced water tanks. Vapors from the active produced water tanks are routed to the common combustion devices for 98% control.

truck loading:

VOC and HAP emissions are based on AP-42 EF and the projected oil production rate.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) associated with truck loading are based on the reported 98% destruction efficiency of the common combustion devices for the vapors recovered.

Per US EPA's AP-42 publication, Section 5.2, tank trucks that pass the NSPS level annual leak test can use a vapor capture efficiency of 98.7%. Chesapeake requires all oil haulers to have their tank trucks certified and they must maintain their certification or they will not be utilized.

natural gas fired heaters: (Emission Source E2, Process Flow Diagram)

NO_x and CO emissions are based on AP-42 EF for fuel boilers and heaters.

fugitive sources: (Emission Source E3, Process Flow Diagram)

VOC and HAP emissions are based on EPA and API EF and the number of fugitive sources at the well sites.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT): The following table summarizes Presumptive BACT notice and control installation requirements under the 2013 Chapter 6, Section 2 Oil and Gas Production Facilities Permitting Guidance (C6 S2 Guidance).

Application, Emissions Controls, Monitoring	Date Due	Date Filed/Installed
Application	N/A	6/24/2015
Oil Tank Emission Control	wells not producing yet	upon startup
Water Tank Emission Control	not required	upon startup
Continuous Monitoring	wells not producing yet	upon startup

The emission control, reporting and monitoring requirements under the 2013 C6 S2 Guidance have been met.

Since this facility is potentially a major source of VOCs, conditions requiring one (1) quarterly inspection per year be done with an optical gas imaging instrument have been incorporated into this proposed permit.

VOC emissions associated with truck loading are estimated to be 501.3 TPY. The 2013 C6 S2 Guidance requires a BACT analysis for emission sources with greater than 8 TPY VOC. Chesapeake will utilize a vapor collection system and NSPS certified tanker trucks for the truck loading operation that are assumed, based on AP-42 Section 5.2, to capture 98.7% of the truck loading vapors. The captured vapors are routed to the common smokeless combustion devices with reported destruction efficiencies of 98% which reduces emissions to 10.0 TPY VOC. The Division finds this level of control to satisfy BACT requirements for truck loading operations.

NEW SOURCE PERFORMANCE STANDARDS (NSPS): The oil storage tanks are operated prior to custody transfer and are not subject to Subpart K, K_a or K_b.

40 CFR part 60, subpart OOOO - *Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution* applies to any new, modified or reconstructed emission source installed after August 23, 2011 at oil and gas production and gas processing facilities. The Smith Creek 8-32-70 B PAD is subject to 40 CFR part 60, subpart OOOO as the facility was constructed after the effective date.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels defined in WAQSR Chapter 6, Section 4.

CHAPTER 6, SECTION 3 (Operating Permit): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels defined in WAQSR Chapter 6, Section 3.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (MACT): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels of 10 TPY of any individual HAP and 25 TPY of any combination of HAPs; therefore this facility is not subject to Subpart HH requirements for oil and gas production facilities which are major sources of HAP emissions.

PROPOSED PERMIT CONDITIONS: The Division proposes to issue an Air Quality Permit to Chesapeake Operating, LLC for the Smith Creek 8-32-70 B PAD with the following conditions:

1. Authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or being installed for the purpose of investigating actual or potential sources of air pollution and for determining compliance or non-compliance with any rule, regulation, standard, permit or order.
2. All substantive commitments and descriptions set forth in the application for this permit, unless superseded by a specific condition of this permit, are incorporated herein by this reference and are enforceable as a condition of this permit.

3. A permit to operate in accordance with Chapter 6, Section 2(a)(iii) of the WAQSR is required after a 120-day start-up period in order to operate this facility.
4. All notifications, reports and correspondence required by this permit shall be submitted to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002 and a copy shall be submitted to the District Engineer, Air Quality Division, 152 North Durbin Street, Suite 100, Casper, WY 82601. Submissions may also be done electronically through <https://airimpact.wyo.gov> to satisfy requirements of this permit.
5. All records required under this permit shall be kept for a period of at least five (5) years and shall be made available to the Division upon request.
6. Periodic training on the proper operation of equipment, systems and devices used to contain, control, eliminate or reduce pollution shall be provided to company personnel whose primary job is to regularly ensure that facility production equipment is functional. The training shall provide these personnel with the ability to recognize, correct and report all instances of malfunctioning equipment, systems and devices associated with air pollution control. These equipment, systems and devices include, but are not limited to combustion units, reboiler overheads condensers, hydrocarbons liquids storage tanks, drip tanks, vent lines, connectors, fittings, valves, relief valves, hatches and any other appurtenance employed to, or involved with, eliminating, reducing, containing or collecting vapors and transporting them to a pollution control system or device.
7. Trained personnel shall perform, at a minimum, a quarterly site evaluation of the operation of the air pollution control equipment, systems and devices under Condition 6. The first quarterly site evaluation shall be conducted within the second quarter after startup of the facility.
8. At least one of the quarterly evaluations per calendar year under Condition 7 shall include an evaluation of the facility for leaks from the equipment, systems and devices under Condition 6 using an optical gas imaging instrument. Monitoring utilizing the no detectable emissions test methods and procedures in 40 CFR §60.5416(b)(1) through (8) may be utilized to satisfy the requirements of this condition for the equipment, systems, and devices under Condition 6 in lieu of using an optical gas imaging instrument.
9. Notification shall be provided to the Division at least fifteen (15) days prior to each quarterly evaluation under Condition 7.
10. An annual preventative maintenance program shall be instituted to inspect and replace equipment, systems and devices under Condition 6 as necessary to ensure their proper operation.
11. Results of all inspections, evaluations and periodic monitoring shall be documented and maintained for review by the Division upon request. Digital files of any optical gas imaging instrument evaluations need not be maintained.
12. Vapors from all oil tanks and all active produced water tanks, including tank flash and S/W/B vapors, shall be routed to the common combustion devices to reduce the mass content of VOCs and HAPs in the vapors vented to the devices by at least ninety-eight percent (98%) by weight.

13. Flash gas from the vapor recovery tower shall be collected by the vapor recovery unit and routed to the gas sales pipeline.
14. Truck loading vapors shall be routed to a vapor collection system using NSPS certified tanker trucks and the captured vapors shall be routed to the common combustion devices to reduce the mass content of VOCs and HAPs in the captured truck loading vapors by at least ninety-eight percent (98%) by weight. Chesapeake Operating LLC shall keep records of the tanker truck certifications.
15. The presence of the combustion device pilot flames shall be monitored using thermocouples and continuous recording devices or any other equivalent devices to detect and record the presence of the flames. Records shall be maintained noting periods during active well site operation when any of the pilot flames are not present. The records shall contain a description of the reason(s) for absence of the pilot flames and steps taken to return the pilot flames to proper operation.
16. The common combustion devices shall be designed, constructed, operated and maintained to be smokeless, per Chapter 3, Section 6(b)(i) of the WAQSR, with no visible emissions except for periods not to exceed a total of five (5) minutes during any two (2) consecutive hours as determined by 40 CFR part 60, appendix A, Method 22.
17. The emergency flares shall be designed, constructed, operated and maintained to meet the requirements of Chapter 3, Section 6 of the WAQSR.
18. Emission control equipment, including the VOC and HAP emission control system or device, all vent lines, connections, fittings, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, shall be maintained and operated during any time the well is producing such that the emissions are controlled at all times. Records shall be maintained noting dates and durations of times during such operation when any VOC or HAP emissions control system or device or the associated containment and collection equipment is not functioning to control emissions as required by this permit.
19. Emissions from this facility shall not exceed the major source threshold as defined in Chapter 6, Section 3 of the WAQSR.
20. Chesapeake Operating, LLC shall comply with all applicable requirements of 40 CFR part 60, subpart OOOO.
21. Chesapeake Operating, LLC shall submit startup notification to the Division within thirty (30) days after the Smith Creek 8-32-70 B PAD, consisting of the Smith Creek 8-32-70 B SX 5H, B SX 7H and B SX 9H well sites are connected to the Smith Creek 8-32-70 B PAD.

Conditions applicable to blowdown/venting operations at the Smith Creek 8-32-70 B PAD:

22. All notifications, reports, and correspondence required by this permit shall be submitted to the O&G permitting engineer, 152 North Durbin Street, Suite 100 Casper, WY 82601 and a copy shall be submitted to the District Engineer, Air Quality Division, 152 North Durbin Street, Suite 100, Casper, WY 82601. Submissions may also be done electronically through <https://airimpact.wyo.gov> to satisfy requirements of this permit.
23. Emissions of volatile organic compounds (VOC) and hazardous air pollutants (HAP) resulting from episodes of manual and automatic blowdown and venting of hydrocarbon fluids (liquids and gas) associated with liquids unloading, well purging, wellbore depressurization, hydrate clearing, emergency operations, equipment depressurization, etc., shall be minimized to the extent practicable.
24. During manual blowdown and venting episodes, personnel shall remain on site for the duration of the episode to ensure minimal gas venting occurs by ending the episode as soon as possible once the intended purpose for the episode has been accomplished. The requirement for the personnel to remain on site does not apply to automated blowdown and venting episodes and does not apply to any episode where remaining on site might be considered a safety hazard.
25. For all manual and automatic blowdown and venting episodes the following shall be recorded.
 - A. Facility name and legal location (Section, Township, Range, County) and associated Air Quality Permit number;
 - B. Date, duration, start and end time;
 - C. Reason for episode, i.e. unload well by venting well tubing to blowdown tank, relieve annulus pressure, depressurize well for downhole repair, etc.;
 - D. Measure(s) taken to ensure emissions were minimized to the extent practical;
 - E. Name of person(s) remaining on site for the duration of manual blowdown and venting episode;
 - F. Summary of total volumes of hydrocarbon fluids (barrels of oil, condensate, and water and MCF of gas) recovered and vented;
 - G. Estimated pounds of VOC and HAP emissions associated with the vapors vented to the atmosphere.
26. VOC and HAP emission estimates required under Condition 25(G) shall be determined using the spreadsheets illustrated in Appendix A. The spreadsheets are available for download from the DEQ/AQD website or may be obtained upon request. An emission estimation method other than that provided by the Division may be used upon approval.
27. Within nine (9) months after the date of well startup, a summary of the information recorded under Condition 25 shall be submitted to the Division. The data required under Condition 25 shall be collected for a minimum of six (6) months after the date of well startup and shall include all gas analyses used as sources for the input information in the spreadsheets required under Condition 26.

28. The Division will reopen and revise this permit, as necessary, to add or delete requirements should the Division determine that:
 - A. The practical application of the terms and conditions of the permit are unfeasible or fail to achieve the intent of the permit, or;
 - B. The monitoring, recordkeeping, notification or reporting requirements are inadequate to assure compliance with applicable requirements.

EQUIPMENT LIST

- three (3) unheated inlet separators
- three (3) heater treaters w/ 0.5 MMBtu/hr heaters
- one (1) vapor recovery tower
- eight (8) 400-bbl oil storage tanks
- four (4) 400-bbl produced water tanks
- one (1) electrically-driven vapor recovery unit (VRU)
- two (2) smokeless emergency flares (produced gas control during upset conditions)
- one (1) smokeless emergency air-assisted flare (vapor recovery tower flash emissions control during upset conditions)
- two (2) common smokeless combustion devices w/ continuous pilot monitoring systems (oil tank, active produced water tank and truck loadout emissions control)

EMISSIONS SUMMARY

Smith Creek 8-32-70 B PAD 13,760 BPD total oil ¹				
SOURCE	EMISSIONS (TPY) ²			
	VOC	HAP	NO _x	CO
Oil Tanks (flashing and S/W/B)				
UNCONTROLLED	387.9	18.5		
CONTROLLED	7.8	0.4	1.1	0.3
Truck Loading				
UNCONTROLLED	501.3	24.0		
CONTROLLED	10.0	0.5	1.4	0.3
Process Heaters				
	insig	insig	0.9	0.7
Fugitives				
	7.0	0.3		
Total Uncontrolled Facility Emissions				
	896.2	42.8	0.9	0.7
Total Controlled Facility Emissions				
	24.8	1.2	3.4	1.3

¹ daily rates projected by the applicant

² rounded to the nearest 0.1 ton

Appendix A

Blowdown/Venting Spreadsheet

Spreadsheet for calculating emissions associated with gas vented from ANNULUS when there is an associated pressure drawdown ($P_1 > P_2$).

INPUT		CALCULATED	
Gas HAP Content (wt%)	6		
Gas VOC Content (wt%)	15		
Gas Compressibility (Z)*	0.98		
Gas Molecular Weight	17.74	lb/lbmol	
Universal Gas Constant (R)	10.732	ft ³ psi/°R lb-mol	
Starting Pressure (P ₁)	1500	psig	1512 psia
Ending Pressure (P ₂)	0	psig	12 psia
Starting Temperature (T ₁)	55	°F	515 °R
Ending Temperature (T ₂)	55	°F	515 °R
Tubing Outside Diameter (OD)	2.875	in	4.9521 lb/ft ³
Casing Inside Diameter (ID)	3.92	in	0.0393 lb/ft ³
Annulus Length (AL)	500	ft	4.9128 lb/ft ³
			0.0387 ft ³ /ft
		Starting Gas Density (ρ ₁)	ρ ₁ =(P ₁ *MW)/R*T ₁ *Z
		Ending Gas Density (ρ ₂)	ρ ₂ =(P ₂ *MW)/R*T ₂ *Z
			ρ ₁ - ρ ₂
			Annular Volume per Linear Foot (AV)
		Gas Release	95 lb
		Pounds of Gas per Linear Foot = (ρ ₁ - ρ ₂) * (AL) * (AV)	
		Gas Release	2,032 SCF
		Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol))	
		VOC Release	14 lb
		VOC release = (Gas Release (lb)) * (Gas VOC Content / 100)	
		HAP Release	6 lb
		HAP release = (Gas Release (lb)) * (Gas HAP Content / 100)	

Tubing Sizes			Casing Sizes		
nom.	OD inches	ID inches	nom.	OD inches	ID inches
2 3/8	2.375	1.94	4 1/2	4.5	3.92
2 7/8	2.875	2.26	4 3/4	4.75	4.2
3 1/2	3.5	2.76	5	5	4.41
			5 1/2	5.5	4.82

* For the purposes of this spreadsheet, assume the starting Z factor = the ending Z factor.

Spreadsheet for calculating emissions associated with gas vented from tubing or casing when there is an associated pressure drawdown ($P_1 > P_2$)

INPUT	
Gas VOC Content (wt%)	50
Gas HAP Content (wt%)	6
Gas Compressibility (Z)*	0.95
Gas Molecular Weight	17.74 lb/lbmol
Universal Gas Constant (R)	10.732 ft ³ psi/°R lb-mol

CALCULATED

Starting Pressure (P_1)	600 psig	612 psia
Starting Temperature (T_1)	600 °F	1060 °R
Ending Pressure (P_2)	200 psig	212 psia
Ending Temperature (T_2)	55 °F	515 °R

Tubing Sizes			Casing Sizes		
nom.	OD inches	ID inches	nom.	OD inches	ID inches
2 3/8	2.375	1.94	4 1/2	4.5	3.92
2 7/8	2.875	2.26	4 3/4	4.75	4.2
3 1/2	3.5	2.76	5	5	4.41
			5 1/2	5.5	4.82

Tubing or Casing Inside Diameter (ID)	1.875 in	Starting Gas Density (ρ_1)	1.0046 lb/ft ³	$\rho_1 = (P_1 * MW) / (R * T_1 * Z)$
Tubing/Casing Length (TL)	15000 ft	Ending Gas Density (ρ_2)	0.7163 lb/ft ³	$\rho_2 = (P_2 * MW) / (R * T_2 * Z)$
			0.2883 lb/ft ³	$\rho_1 - \rho_2$
			0.0192 ft ³ /ft	Volume per Linear Foot (TV)

Gas Release	83 lb	Release = $(\rho_1 - \rho_2) * (TL) * (TV)$
Gas Release	1772 SCF	Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol))
VOC Release	41 lb	VOC release = (Gas Release (lb)) * (Gas VOC Content / 100)
HAP Release	5 lb	HAP release = (Gas Release (lb)) * (Gas HAP Content / 100)

* For purposes of these calculations assume starting Z = ending Z.

Spreadsheet for calculating blowdown/venting emissions from tubing, casing or annulus when there is minimal or no pressure differential during the event ($P_1 = P_2$)

	INPUT		CALCULATED
	↓		
Average Daily Gas Production Rate	1	MSCFD	
Vented Gas VOC Content	50	wt%	
Vented Gas HAP Content	35	wt%	
Vented Gas Molecular Weight	20	lb/lb-mol	
Blowdown Duration	120	minutes	
			↓
		Total Gas Emitted	0.083 MSCF
		VOC Emissions	2.2 lbs
		HAP Emissions	1.5 lbs

Fill in the five parameters below.