Appendix 9-C

Conceptual Model Plan

Conceptual Model Plan

Date: 24 June, 2014

Facility Name, Company and Location (Lat., Long.):

Harper Creek Project
Yellowhead Mining Inc.
51°33'N 119°42W

Air Quality Consultant and Contact Name:

ERM Consultants Canada Ltd (Rescan)
15th Floor, 1111 West Hastings Street
Vancouver, BC V6E 2J3
Tel: 604-689-9460
Fax: 604-687-4227
Website: www.rescan.com

Contact name: Mark Branson and Kiri Heal

Ministry Contact (Air Quality Assessment):

Ralph Adams

Assessment Type: ***Answer 2 or 3.***

A Level 2 Assessment will be required for the Project's environmental assessment Application. The environmental assessment will include the predicted concentrations of suspended particulate matters (as total suspended particulates, PM_{10} and $PM_{2.5}$) and total (dry+wet) dust deposition. The model results will provide information to be used to determine effects of the air emissions on biological receptors such as human health. The results will be compared with applicable federal and provincial ambient air quality guidelines and standards.

Anticipated sources to be modelled and corresponding contaminants:

The Harper Creek Project (the Project) is a proposed open pit copper mine located in south-central British Columbia (BC), approximately 150 km northeast by road from Kamloops. It is centered at approximately 51º30'N latitude and 119º48'W longitude, and is situated at approximately 1800 metres above sea level (masl). The closest community is unincorporated municipality of Vavenby which is located about 10 km north of the Project.

The Project consists of a 70,000 tonnes/day conventional copper concentrator and a combined electric and diesel powered open pit mining operation. The reserves will be mined by open pit methods in five phases of open pit development and expansion. The overall mine life is 28 years after start-up of the concentrator.

Mill feed and waste rock will be drilled by electric and diesel powered rotary drills and blasted using ammonium nitrate and fuel oil. Mill feed and waste rock will be loaded into diesel mine trucks by electric hydraulic shovels and a wheel loader. Potential acid generating (PAG) waste rock will be placed in the Tailings Management Facility (TMF). Non-potentially acid generating (non-PAG) waste rock will be placed in the valley to the west of the pit. Non-PAG and PAG low grade will be stockpiled separately to the south west of the plant site adjacent to the TMF Direct mill feed will be hauled to the primary crusher located south west of the open pit. Crushed ore will be conveyed to the coarse ore stockpile and subsequently to the crushing, grinding, and flotation sections of the process plant.

The concentrator design is conventional with primary crushing followed by grinding and flotation, producing a simple copper gold concentrate that will be dewatered and trucked to nearby Vavenby, BC and stored in an off-site facility capable of storing two days of concentrate production at a time. The copper concentrate will then be loaded on railcars and transported by train to Vancouver for shipment to overseas smelters. The final flotation tailings will be disposed by pipeline to the TMF using the conventional tailing storage method. Resources will be mined from the open pit and hauled directly to the crusher for 23 years. The implementation of an elevated cutoff grade strategy results in a low grade stockpile at the end of the open pit life. This material will be reclaimed and processed for another 5 years.

The mine has an electrical load demand of about 9.7 MW that will be supplied by a 12 km long 138 kV powerline from the mine site to a substation near Vavenby. Power will be supplied by provincial network therefore there will not be any diesel generators at site, except two during the construction period and an emergency backup generator during operations. Additionally, the sulphur content in diesel fuel has been reduced to 15 mg/kg effective at all Provinces and Territories since October 2010 (EC 2012[1]) therefore sulphur dioxide and reduced sulphur emissions are not significant.

The largest air emission sources are determined as mining equipment and vehicles. Blasting will take place on a regular basis. The anticipated air emission sources and characteristics are summarized in Table 1. Preliminary air emission estimates suggest that suspended particulate matter (TSP, PM_{10} and $PM_{2.5}$) and total particulate matter (as dustfall) are potential risk factors therefore they should be modelled to predict concentrations in the study area. Since the size of the project does not require significant amount of equipment and vehicles, gaseous criteria air contaminants such as sulphur dioxides, nitrogen oxides, carbon monoxides, and volatile organic carbons are not anticipated as high risk factors for the Project. These potential contaminants will, therefore, not be included in the modelling study.

Air emission rates will be estimated by using the most recent USEPA AP42 emission factors, approved emission limits, manufacturer specifications USEPA's NONROAD2008 software, and other relevant references if required. The engineering feasibility study will be used to quantify and locate the air emission sources. The production summary and construction schedule will be the main sources to determine the year which will be modelled for the environmental assessment.

[1] EC (Environment Canada). 2012. Sulphur in Diesel Fuel Regulations. Maximum Sulphur Limits for Diesel Fuel. Available at https://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=7A8F92ED-1

Table 1. Summary of Sources and Contaminants

Source	Source Type (point, line, area, volume)	Contaminant(s)
Open Pit activities	Area	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$), SO_2, NO_2, CO
Transfer Points	Volume	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$), SO_2, NO_2, CO
Open Stockpiles	Area	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$)
Crushers	Point	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$)
Process Plant	Point	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$), SO_2, NO_2, CO
Haul Roads	Area	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$), SO_2, NO_2, CO
Access Roads	Area	Particulate matter (Dustfall, TSP, PM_{10}, $PM_{2.5}$), SO_2, NO_2, CO

Note: Underlined contaminants will be modelled.

Anticipated model domain and receptors (preliminary domain dimension, receptor grid/locations, sensitive receptors)

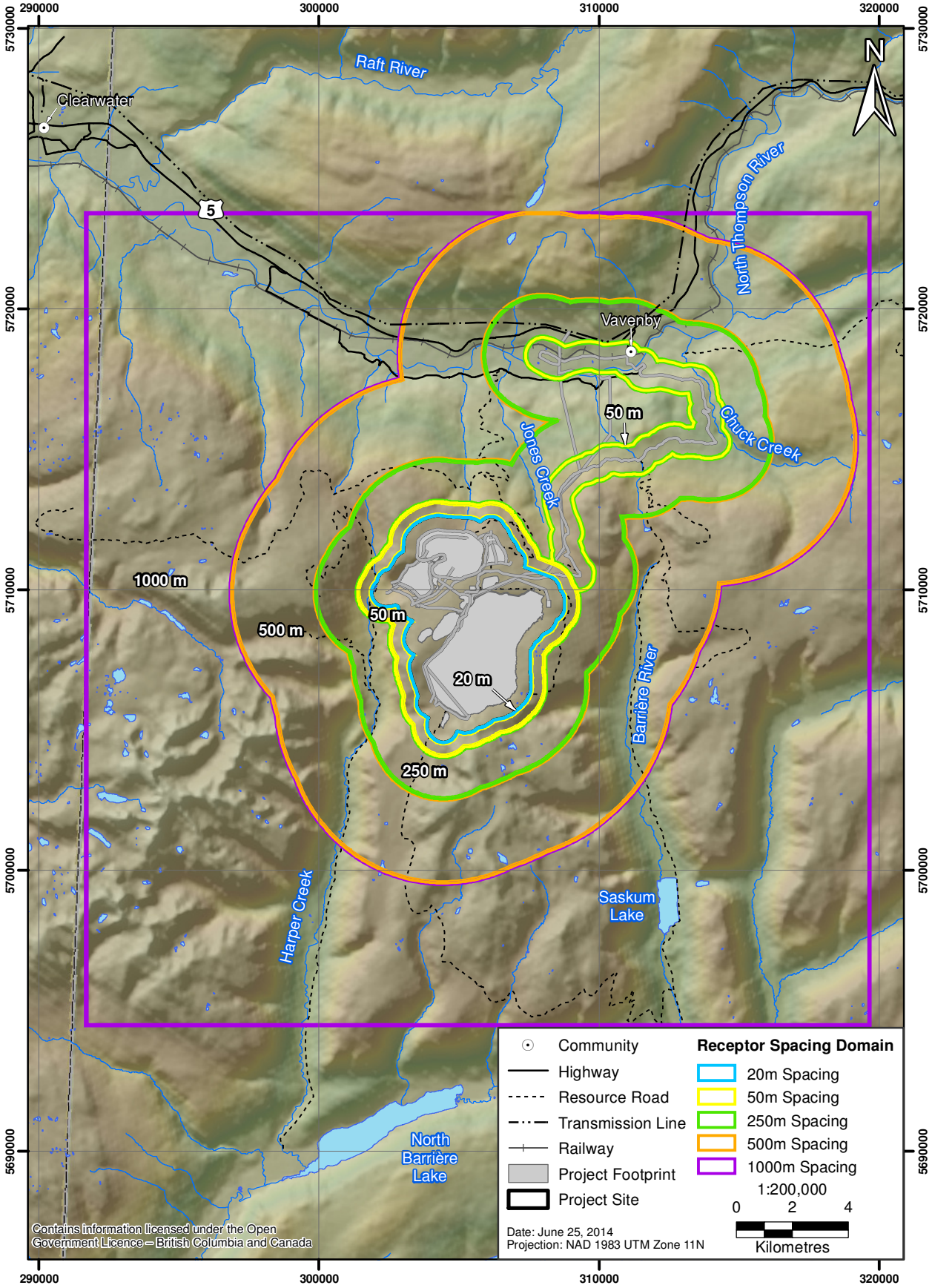
The domain is centered on the proposed Project, and extends 10 km from the Project Site (Figure 1). The domain is 28 km by 29 km. The area is expected to contain isopleths that represent 10% of the ambient air quality objectives. The receptors were configured according to the suggested receptor spacing in the Guidelines for Air Quality Dispersion Modelling in British Columbia (BC MOE 2008):

- 20 m receptor spacing along the Project Site;
- 50 m spacing within 500 m of Project Site and access road;
- 250 m spacing within 2 km of Project Site and access road;
- 500 m spacing within 5 km of Project Site and access road; and
- 1,000 m spacing beyond 5 km of Project Site and access road.

Sensitive receptors will also be included in the modelling at relevant human health receptors, including receptors in Vavenby and Birch Island, and at camp and cabin locations.

Figure 1

Proposed Modelling Domain and Receptor Spacing



Terrain characteristics within domain: flat terrain or complex terrain (i.e., will complex flow need to be considered?)

The Harper Creek project is located about 10 kilometers from Vavenby, in the Kamloops region of south central British Columbia, approximately 150 kilometers north-east by road from Kamloops. Terrain has typical central BC characteristics and can be considered as complex terrain due to mountains in the project area.

Dominant land cover: forested, urban, industrial, rock, water, grassland:

The GeoBC land use data (BTM – Baseline Thematic Mapping) were used for this assessment. The land use breakdown is shown below:

- Forest land 77%
- Rangeland 12%
- Barren land 7%
- Agricultural land – irrigated 3%
- Urban, water, and wetland add up to 1%

Existing air quality situation (pristine, industrial, urban):

The area can be considered as non-urban. Two small communities, Vavenby and Birch Island are located approximately 10 km to the northeast and northwest, respectively, Clearwater is located over 20 km to the northwest. There are a few industrial developments in the proposed air dispersion modelling domain.

Air quality monitoring program was commenced in 2011 and initial results show that the existing air quality at project site is pristine in terms of settled particulate matter. The air quality monitoring program will continue to augment data to characterize the background concentrations which will be an important part in air quality assessment.

Potential meteorological data sources (site specific or offsite measured surface/upper-air, mesoscale model data):

In December 2007 a 3-metre high climate station was installed to monitor wind speed, wind direction, gust speed, relative humidity, temperature, barometric pressure, and rainfall. This station was operated until April 2011. Data from this station is not considered suitable for modelling due to the low height of the station, which can easily be covered in snow during the winter.

In August 2011 a 10-metre climate station was installed. The station remains active and receives regular inspections and maintenance. This self-powered station monitors the following parameters on an hourly and daily basis:

- Wind Speed
- Wind Direction
- Temperature
- Relative Humidity
- Atmospheric Pressure
- Incoming Solar Radiation
- Net Solar Radiation
- Total Precipitation, and
- Snow Depth.

Details of the two onsite meteorological stations are shown in Table 2.

The model will be run for the year 2013, using the 10-metre station. The data capture is over 90% for 2013. On-site meteorological data will be processed for quality assurance and the final results will be converted to model compatible format which is readable by the air dispersion model.

There is also a meteorological station at Clearwater, operated by BC Wildfire Management Branch. The completeness of data is over 90% for wind speed, wind direction, temperature and relative humidity, therefore the hourly data from Clearwater station will also be used as a part of surface data file. A larger meteorological domain (50 x 50 km) will be prepared to incorporate the Clearwater station in the meteorological model (CALMET).

Currently there is no upper-air data in the area, the closest upper air station is Kelowna which is approximately 180 km south; therefore data will be obtained from mesoscale meteorological model output (MM5) data. The MM5 domain used is 50 x 50 km, with resolution of 4 km. A CALMET resolution of 1 km is used. In order to assess the reliability of the MM5 data wind roses were extracted for various locations across the study area. The wind roses and meteorology station locations are shown in Figure 2.

Figure 2

Meteorology Stations and Wind Roses

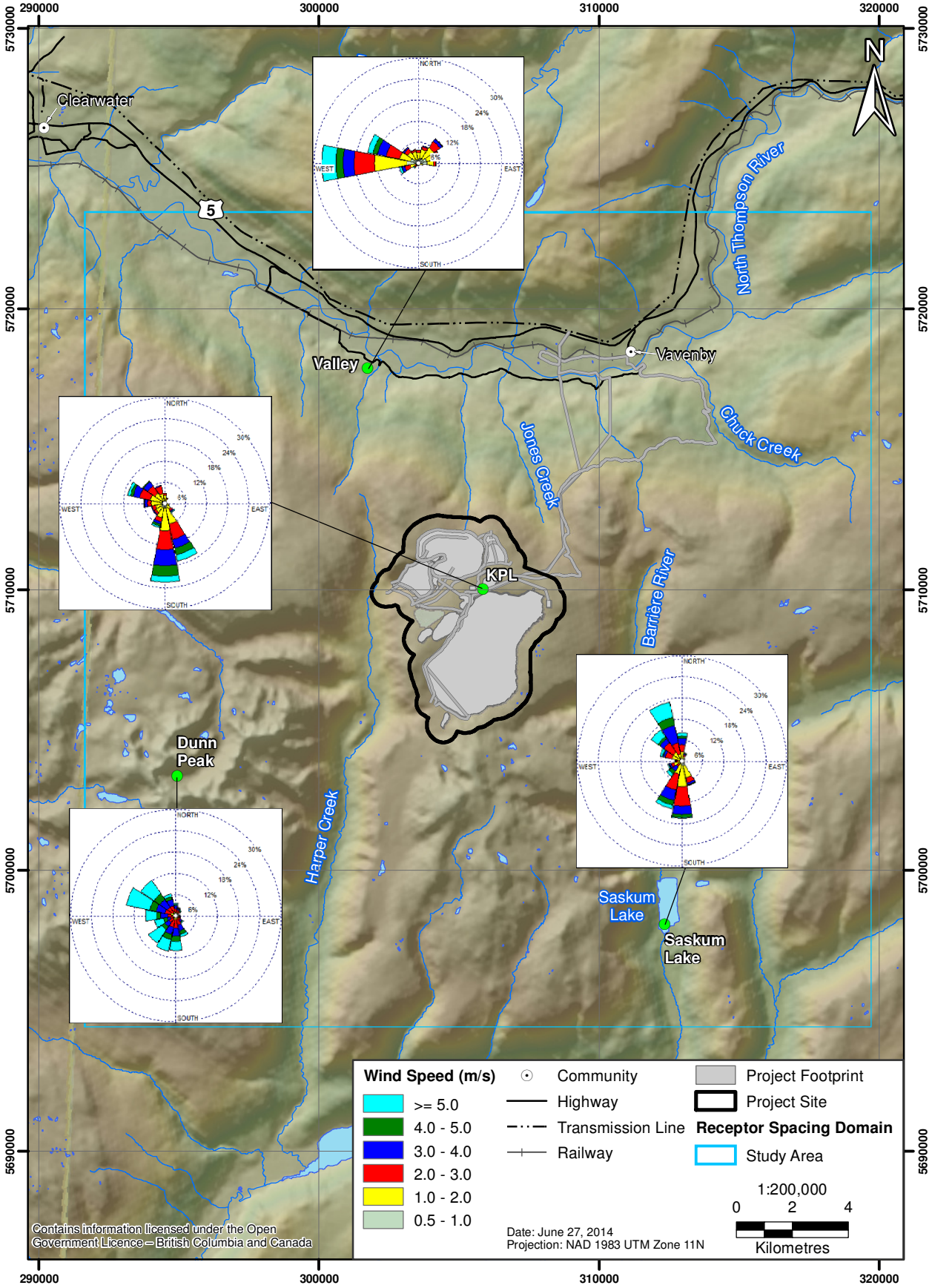


Table 2. Summary of Onsite Meteorology Stations

	Activity period	Meteorological Parameters									
		Wind Seed	Wind Direction	Temperature	Relative Humidity	Atmospheric Pressure	Solar Radiation/	Net Solar Radiation	Rainfall	Total Precipitation	Snow Depth
KPL Climate Station[a]	Sept 2011 - Present	X	X	X	X	X	X	X		X	X
DCL Climate Station[b]	Dec 2007 – Apr 2011	X	X	X	X	X			X		
Clearwater	1976 - Present	X	X	X	X					X	

[a] *KPL station is a standard 10 m station.*

[b] *DCL station is mounted on a 3 m tripod.*

Identify possible model(s) to be applied:

The CALPUFF air dispersion modelling system is proposed for the environmental assessment for the following reasons:

- Complex terrain and meteorological conditions associated with mountains near the project area;
- Multiple air emission sources (point, area, and volume);
- Distribution of the pollutant concentrations (suspended particulate matter) and/or deposition (in terms of dustfall) in time and space is required; and
- Calms winds (<1 m/s) can be treated.

The air dispersion model proposed for this assessment is the latest US EPA-approved version of CALPUFF.

Identify any potential modelling requirements due to Canada/U.S. transboundary issues:

Not applicable due to distance from the nearest US border.

Anticipated ministry review completion date of conceptual model plan:

Ideally the review will be completed by July 4th to allow time to update our modelling methodology and prevent the need for re-runs.

Ministry Acceptance of Plan:_____ Date:_____