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Health Impact Assessment for Proposed Coal Mine at Wishbone Hill, Matanuska-Susitna Borough Alaska

Prepared For:

Alaska Department of Health and Social Services,

Health Impact Assessment Program

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Exhibit 10

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LIST OF TABLES

LIST OF FIGURES

1.4.3.3 Comprehensive HIA

The hallmark of the comprehensive HIA is collection of new data, to address critical data gaps identified during the scoping process. A comprehensive HIA also pursues extensive stakeholder engagement. A comprehensive HIA may be appropriate for projects that involve:

- Resettlement of existing communities;
- Significant population influx;
- Major disruption of subsistence practices;
- Major impacts to key social determinants of health; and,
- Information gaps related to a well-known aspect of a project.

The WHM HIA utilizes a rapid appraisal strategy. WHM is a permit modification within an existing permitted mining lease and the HIA was performed within a restricted time frame, which precluded extensive field study. This HIA identifies potential project impacts, positive or negative, in a timely fashion for decision makers and stakeholders. The rapid appraisal HIA strategy is fully capable of identifying potentially critical impacts and data gaps. Data gaps may be informational, temporal, spatial or related to the quality of existing information. The identification of a “data gap” does not automatically imply that fieldwork is either recommended or must be performed.

A major goal of this HIA is to accurately inform decision makers and stakeholders regarding potential impacts based on the current set of available data. The HIA identifies the areas where additional data, including field investigation, would enhance the analysis.

1.4.4 HIA Scope

This HIA reviews the proposed WHM based on the following information:

- Permit application materials submitted by the project proponent, Usibelli Coal Mine (UCM);
- Comments and concerns raised during focus groups and public consultation meetings held by the relevant State of Alaska agencies including, ADNR, Alaska Department of Environmental Conservation (ADEC), and ADHSS
- General parameters developed by the July 2011 “Alaska Technical Guidance for Health Impact Assessment”.

1.4.4.1 Areas outside the scope of the HIA

The study does not address classic occupational health concerns (e.g., physical hazards or environmental hazards encountered while working), which are referred to as ‘inside the fence’ and are thoroughly addressed by federally mandated health and safety protocols.

1.4.5 Health Effect Categories (HECs)

The Alaska HECs, shown below in Table 1, are a standard set of effects categories that have been developed and published in the July 2011, “Technical Guidance for Health Impact Assessment (HIA) in Alaska.”

Table 1 Health Effects Categories[1]

Health Effects Category	Pathway Description
Social Determinants of Health (SDH)	This is a broad category that considers how living conditions and social situations influence the health of individuals and communities. ◆ psychosocial issues related to drugs and alcohol, ◆ teenage pregnancy ◆ family stress ◆ domestic violence ◆ depression & anxiety ◆ isolation ◆ work rotations and hiring practices, ◆ cultural change ◆ economy, employment, and education Limitations: While SDH are real and important, it is extremely difficult to establish direct causality between a change in a social determinant and a particular health outcome at a population-level. In addition, this HEC involves aspects of wellbeing that are by nature difficult to quantify and objectively measure (e.g., negative emotions, stress, anxiety, depression, etc). The language used to communicate impacts related to social determinants should reflect that SDH influence health in complex ways.
Accidents and Injuries	This category includes impacts related to both fatal and non-fatal injury patterns for individuals and communities. Changed patterns of accidents and injuries may arise due to: ◆ Influx of non-resident personnel (increased traffic on roadways, rivers, air corridors ◆ Distance of travel required for successful subsistence. ◆ Project-related income and revenue used for improved infrastructure (e.g., roadways) and improved subsistence equipment/technology.
Exposure to potentially hazardous materials	This category includes project emissions and discharges that lead to potential exposure. Exposure pathways include: ◆ Food. Quality changes in subsistence foods (risk based on analysis of foods or modeled environmental concentrations) ◆ Drinking water ◆ Air. Respiratory exposures to fugitive dusts, criteria pollutants, VOCs, mercury, and other substances. ◆ Work. Secondary occupational exposure such as a family member's exposure to lead on a worker's clothing. ◆ Indirect pathways, such as changing heating fuels/energy production fuels in communities.
Food, Nutrition, and	This section depends on the subsistence analysis and nutritional

Subsistence Activity	surveys (if completed) and considers: ◆ *Effect on Diet*: This pathway considers how changes in wildlife habitat, hunting patterns, and food choices will influence the diet of and cultural practices of local communities. While nutritional surveys are the most effective way to assess dietary intake, conclusions can be drawn if certain assumptions are accepted. ◆ *Effect on Food Security*: This discussion considers project-specific impacts that may limit or increase the availability of foods needed by local communities to survive in a mixed cash and subsistence economy present in rural Alaska.
Infectious Disease	This category includes the project's influence on patterns of infectious disease: The pathways include: ◆ Influx of non-resident personnel from outside the region ◆ Crowded or enclosed living & working conditions and the mixing of low and high prevalence populations due to influx can create an increased risk for transmission of STIs such as syphilis, HIV, and Chlamydia. ◆ Changes to groundwater/wetlands can alter habitat for agents that transmit vector-borne diseases. This is not a likely scenario in Alaska, but with the cumulative effects of climate change it may become an issue of greater concern in the future.
Water and Sanitation	This category includes the changes to access, quantity and quality of water supplies. The pathways include: ◆ Lack of adequate water service is linked to the high rates of lower respiratory infections observed in some regions, and to invasive skin infections. ◆ Revenue from the project that supports construction and maintenance of water & sanitation facilities. ◆ Increased demand on water and sanitation infrastructure secondary to influx of non-resident workers.
Non-communicable and Chronic Diseases	This category considers how the project might change patterns of chronic diseases. The pathways include: ◆ Nutritional changes that could eventually produce obesity, impaired glucose tolerance, diabetes, cardiovascular disease. ◆ Pulmonary exposures that lead to tobacco related chronic lung disease, asthma; in-home heat sources; local community air quality; clinic visits for respiratory illness. ◆ Cancer rates secondary to diet changes or environmental exposures. ◆ Increased rates of other disorders, specific to the contaminant(s) of concern.
Health Services Infrastructure and Capacity	This category considers how the project will influence health services infrastructure and capacity. The pathways include: ◆ Increased revenues can be used to support or bolster local/regional services and infrastructure. ◆ Increased demands on infrastructure and services by incoming

	non-resident employees or residents injured on the job, especially during construction phases.

HECs have been developed to identify the full spectrum of possible health impacts related to a specific project. The HEC approach includes all of the biomedical and social concerns originally developed by key international health and development agencies, i.e., the World Health Organization (WHO) and the World Bank Group. In general, while each HEC may not be relevant for a given project, it is still important to systematically analyze the potential for project related impacts (positive, negative or neutral) by careful consideration of each HEC.

1.5 Stakeholder Engagement

The ADHSS HIA program organized and participated in multiple community listening sessions for WHM. The HIA team has reviewed the written notes associated with community meetings held by the relevant State of Alaska agencies. Written comments submitted by the public and reviewed by state agencies e.g., ADEC air permit regulators, have also been reviewed. A separate section (Section 3.0) that details and categorizes the available stakeholder concerns and comments regarding health issues is included in this HIA.

2.0 PLACE, PERSONS, PROJECT

2.1 The Place-Usibelli Mine Site and Environs

2.1.1 Coal History in the Matanuska

Coal lands in the Matanuska area were opened by the Federal government for lease in 1916. Access into the Matanuska Coal Fields was completed in 1917, but the route ascending Moose Creek was not finished for another 6 years. The Wishbone Hill area was the focus of intensive coal mining activity in the years following 1917. The legacy of this activity was apparent as late as 1981 in the form of structures and heavy equipment associated with the various coal mines in the project area. Three mines operated there: Premier (Alaska Heritage Resource Survey site number ANC-475), Buffalo (ANC-439) and Baxter (ANC-476). The Baxter Mine was one of the earliest in the area, with the commencement of coal shipments in 1917. Coal was worked predominantly in the winter months so that it could be sledded to the main Matanuska Branch of the Alaska Railroad. A narrow-gauge spur ascending Moose Creek reached this operation in October of 1923[2]. The first mining operation at the Premier Mine began in 1922. There has been no active, full-scale mining in the Wishbone Hill area since 1983.[3]

2.1.2 Physical Features

The proposed Permit Area is located in Cook Inlet Basin which covers approximately 38,000 square miles in south-central Alaska (Map 3). Technically, Cook Inlet Basin belongs to the subarctic climate category, but the actual climate zones range from maritime to continental near WHM.

The Project area experiences weather similar to communities in the Cook Inlet area. Data from the Alaska Climate Research Center for 1971-2000 indicates an annual mean temperature of 36°F with an

These basic principles underlie the process of quantitative human health risk assessment that has been developed by regulatory authorities such as EPA, ATSDR, and ADEC. The risk assessment process consists of three basic elements:

- Exposure Assessment: Determination of the extent of human exposure based on potentially complete pathways are summarized in the exposure pathway conceptual site model (CSM).
- Toxicity Assessment: Identification of the type(s) of adverse health effects associated with COPCs, and determination of the relationship between exposure (dose) to a COPC and the probability of occurrence of these adverse health effects (response).
- Risk Characterization: Synthesis of exposure and toxicity information to determine the nature and magnitude of potential health risks at a site, including attendant uncertainties.

The following sections present relevant information on the first two risk assessment elements, exposure assessment and toxicity assessment.

5.2 Exposure Assessment

Usibelli Coal Mine, Inc. (UCM) has submitted a surface coal mining permit application (SCMPA) dated May 11, 2011 to the Alaska Department of Natural Resources Division of Mining, Land, and Water.[3] The project includes installation of a coal preparation plant to grind and wash the coal before transport to Point MacKenzie via truck and rail (pending completion of the proposed Point MacKenzie rail extension[62]) for shipment to market. Suburban residential development has occurred in the mine vicinity since the first permit was issued in 1991. There are houses within one-quarter of a mile of the northwest mine boundary, and the haul trucks will pass through towns on the Glenn Highway on their way to Point MacKenzie (Map 6). These activities have the potential to expose off-site residents to site-related COPCs.

Developing an exposure pathway conceptual site model (CSM) is a critical step in evaluating potential human exposures to chemicals. The CSM comprehensively represents current site conditions. It characterizes the distribution of contaminant concentrations across the site and identifies all potential exposure pathways, migration routes, and potential receptors for further analysis. As such, the CSM guides data gathering efforts. According to ADEC guidance, the CSM should distinguish between complete and incomplete exposure pathways. Exposure pathways consist of four elements:

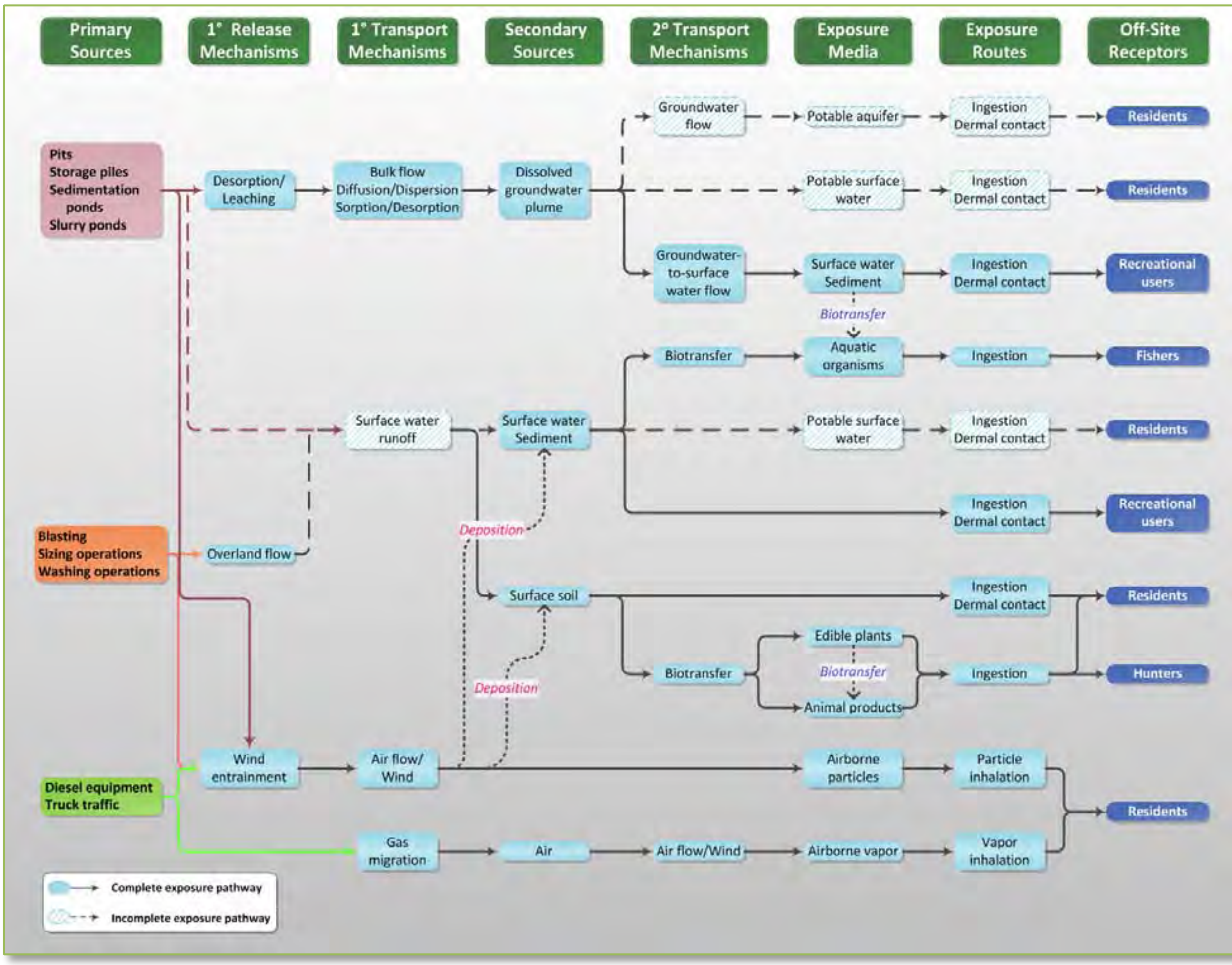
- A source and mechanism(s) of analyte release to the environment
- An environmental transport medium for the released analyte
- A point of potential human contact with the affected medium
- A route of entry into humans (inhalation, ingestion, or dermal contact with the affected medium)

If any of these components is missing, then the pathway is incomplete and does not contribute to receptor exposure. Complete pathways should include both currently complete pathways and any that may be complete in the future based on changes in operations, COPC migration, or changes in land use. *It is important to understand that identifying a pathway as complete does not automatically mean there is actual harm or risk to humans or the environment*. Rather, it means that exposure across the pathway needs further evaluation to determine if it presents a risk.

As shown in Figure 18, the CSM includes:

- Known or potential sources of COPCs
- Environmental media that may contain COPCs, including surface soil, subsurface soil, mined material, groundwater, air, and vegetation
- Primary and secondary release mechanisms that may be associated with each affected medium
- Potential exposure pathways for defined receptors, based on collected data or expected pathways
- Potential human receptor populations

Figure 18 Preliminary Exposure Pathway Conceptual Site Model for the Wishbone Hill Project



A brief discussion of the components of and rationale for the preliminary CSM for the Wishbone Hill Coal Mining and Processing Operation is presented in the following sections.

5.2.1 Sources

Surface coal mining typically involves removal of vegetation and soil and rock overburden, blasting, mucking, loading, hauling, and dumping. In addition to the coal being mined, overlying materials within and adjacent to the deposit are removed. These activities (including day-to-day operations, disposal practices, and accidental releases) are potential sources of particulate matter (PM) consisting of crustal material, coal dust, and exhaust from engines and associated COPCs to air, soil, surface water, and groundwater. As discussed in Part C, Chapter VII (Climatological and Air Quality Information) of the SCMPS[3], there are few significant point sources of air pollution present in the area. However, a variety of other potential dust emission sources do exist, including agricultural activities, and paved and unpaved road emission sources. In addition, Matanuska winds pick up glacial sediment from the Matanuska and Knik River floodplains. Dust occurs most often in the spring and fall when high winds combine with a lack of snow cover. In addition, several area residents have reported winter wind patterns when snow has been blown off of exposed areas. More widespread or regional conditions will also affect the occurrence of wind-blown dust on and around the Site.

While the quantity of solid waste generated by surface coal mining operations is relatively large, much of the waste poses little direct risk of toxicity. That is, typical mining waste is relatively benign in terms of the standard hazardous waste characteristics. No data are presently available concerning specific chemicals of potential concern (COPCs) for UCM. The following categories of sources are anticipated:

Solid waste

- Extraction processes -- overburden material (soil, waste rock, and vegetation), from surface mining
- Tailings from coal preparation processes

Air quality

- Airborne PM
- Extraction processes

Explosives/blasting
Earth moving

- Exhaust from diesel-powered heavy equipment and heaters
- Dust from sizing operations
- Dust from traffic on haul roads
- VOC vapors associated with usage of fuel for heavy equipment

Water quality

- Runoff
- Discharges from coal washing
- Infiltration to groundwater
- Groundwater to surface water transport.

5.2.2 Identification of Chemicals of Potential Concern Associated with Surface Coal Mining Activities

According to EPA Toxics Release Inventory (TRI) data for 2009, the top ten chemicals released by U.S. surface mining operations were (in descending order) barium compounds, manganese compounds, ammonia, zinc compounds, vanadium compounds, lead compounds, copper compounds, chromium compounds, lead, and nickel compounds.[63]

Results of analyses of pilot plant makeup ("fresh") water and coal slurry water (described as clarified process water from thickener overflow) were reported in Part C, Chapter III of the SCMPA ("Overburden and Interburden Assessment") submitted by UCM. According to the study, concentrations of arsenic, barium, chloride, iron, potassium, magnesium, manganese, sodium, and sulfate were higher in process than fresh water. No information on organic constituents was provided. The contribution of these and/or other soil and coal constituents to water and PM that may be transported off-Site is unknown.

There are no active air quality control permits for the Wishbone coal mine project. UCM is in the process of developing a new permit application. Therefore, there are no current measured or modeled concentrations of respirable particles. Based on past experience at other similar mining sites around the world, most likely COPCs that would be expected would be (1) generic PM_{10} and $PM_{2.5}$, and (2) diesel engine exhaust (DEE). It is noted that unidentified inorganic and/or organic constituents in water infiltrating to groundwater from slurry and sedimentation ponds could be COPCs.

5.2.3 Potential Migration Pathways

The concentration and distribution of Site-related COPCs in environmental media on and in the vicinity of the Site could be affected by one or more of the following general mechanisms:

- Suspension and dispersion of overburden soil particles in air in the vicinity of the Site
- Suspension and dispersion of coal dust in air during on-Site sizing operations and from stock piles
- Suspension and dispersion of coal dust in air during transport from the Site to Point MacKenzie, and from stock piles in Point MacKenzie
- Airborne dispersion of PM and vapors from diesel-fueled heavy equipment engines and heaters
- Deposition of airborne soil and coal particles on soil and surface water
- Suspension and dispersion of soil and coal particles in surface water runoff
- Desorption of COPCs from overburden soil and coal and leaching into underlying groundwater
- Migration of dissolved COPCs in groundwater
- Uptake of COPCs into edible plants
- Biotransfer of COPCs into tissues of aquatic animals used as human food
- Biotransfer of COPCs into tissues of terrestrial domestic, game, and subsistence species used as human food
- Biological or chemical transformation of COPCs

5.2.4 Potential Receptor Populations

Residential land use exists in the vicinity of the Site and in Point MacKenzie. According to Part C, Chapters IX and XIII on the SCMPA, recreational uses include hiking and hunting in the Moose Range and salmon fishing in Moose Creek. The residential scenario represents adults and children living full-time in the off-Site area. As the residential scenario involves the greatest potential exposure, it is considered protective of off-Site occupational exposure scenarios. Although subsistence use of resources appears to be unlikely in the area, consumption of recreationally caught fish in Moose Creek and local game as well as domestic livestock and products (milk, meat, eggs) and garden vegetables should also be considered.

5.2.5 Potentially Complete Exposure Pathways

The rationale for selection of potentially complete exposure pathways is discussed in the following sections.

5.2.5.1 Exposure to Particulate Matter and Associated COPCs

PM emitted during mining operations may migrate off the Site and be (1) inhaled by local residents, and (2) deposited on surface soil and surface water. Potential exposures via inadvertent ingestion of and dermal contact with deposited material cannot be evaluated in the absence of information on particle composition, although these exposure pathways are likely to be complete. Potentially complete indirect exposure pathways include biotransfer of COPCs associated with PM matter into edible plants and tissues of game and/or domestic animals maintained in the vicinity.

5.2.5.2 Exposure to Vapors

The only source of vapor emissions from Site activities is expected to be operation of diesel equipment and motor vehicles. Vapors that migrate beyond Site boundaries could be inhaled by local residents.

5.2.5.3 Exposure to COPCs in Groundwater

The majority of residents in the vicinity of the Site obtain potable water from private wells. Baseline groundwater monitoring data collected in the late 1980s and presented in the SCMPA (Part C, Chapter IV, "Hydrogeology") indicated variable but generally moderate to high quality with respect to federal drinking water standards. Recharge to the water table aquifer is from local precipitation. Discharge is primarily to Moose Creek, with some discharge into Buffalo Creek.

According to Part D of the SCMPA ("Operation and Reclamation Plan"), drainage from disturbed areas will be diverted to sediment basins located throughout the mine area. While sediment will be retained in these basins, the runoff water will be allowed infiltrate into the surrounding glacial gravels. This could provide a complete pathway of COPCs to groundwater underlying these structures. The SCMPA indicates that the potentially affected aquifer is not currently used as a potable water source. Therefore, human exposure to COPCs in groundwater could occur via direct contact (ingestion and dermal contact during bathing) is assumed to be unlikely. However, flow of affected groundwater into surface water bodies could provide complete exposure pathways.

5.2.5.4 Exposure to COPCs in Surface Water

Surface water bodies in the Site vicinity include Wishbone Lake, Elk's Lake, and several unnamed lakes and ponds. Moose Creek bounds the Site to the north and west, and is the major surface stream in the area. It flows into the Matanuska River. Buffalo Creek flows across the Site from Wishbone Lake to Moose Creek. Premier Creek flows into Moose Creek from the north and does not cross the Site.

Water quality data presented in the SCMPA (Part C, Chapter V, "Surface Water Hydrology") indicate that the surface waters of the Moose Creek watershed are of high quality when compared to most water quality standards, and there is no evidence of physical or biological pollution in the surface waters. According to the SCMPS (Part C, Chapter VI, "Surface Water and Groundwater Rights and Uses"), local surface water is not used as a source of potable water in the area. However, these water bodies may be used by local residents for camping, hunting, and fishing. As noted in Section 4.2.5.3, surface drainage from disturbed areas will be controlled and routed to sedimentation basins and control ponds designed to prevent discharge to existing surface waters. However, the runoff water will be allowed infiltrate into the surrounding glacial gravels, thereby providing a potentially complete pathway of COPCs to surface water via groundwater-to-surface water flow. In addition, PM could be deposited on surface water bodies. COPCs associated with surface water and sediment could be contacted by recreational users, and taken up by organisms consumed by humans.

5.3 Toxicity Assessment

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for COPCs to cause adverse effects in exposed individuals. It relies upon toxicity criteria developed by EPA and other authoritative bodies. These toxicity criteria are based on information developed through both toxicological studies investigating the effects of known doses on experimental animal species, and epidemiological studies investigating the effects of chemical exposures on human populations. As discussed in the preceding section, the only COPC that can be identified based on existing information is PM_{10}.

5.3.1 General Principles

Toxicology is the field of science that investigates and describes whether and how exposure to environmental factors causes adverse (toxic) effects in organisms, including humans. The central tenet of toxicology is that the effect of any chemical in a biological system is determined by the magnitude and timing of exposure (dose rate). This concept was famously articulated in the 16th century by the physician Paracelsus:[64]

> "What is there that is not poison? All things are poison, and nothing is without poison: the dose alone makes a thing not poison."

Simply put, the toxic effects of a given chemical depend on dose (how much), frequency of exposure (how often), duration of exposure (how long), and the route by which the chemical enters the body (ingestion, inhalation, dermal absorption) – not simply by the fact of exposure itself.

Accordingly, estimation of the health risks that result from exposure to a chemical requires knowledge of (1) the intrinsic hazard posed by a chemical, and (2) the dose or concentration that people are exposed to. It is important to clearly distinguish between the concepts of "hazard" and "risk" in this context. The term "hazard" refers to the effect(s) potentially caused by a chemical, without regard to the dose or exposure. "Risk" refers to the likelihood that an adverse health effect will occur under defined exposure conditions. For example, pure vitamin D is highly toxic, but a small amount is required daily for good health. Thus, hazard is not synonymous with risk, but is rather a component of risk whose importance is strictly determined by exposure.

Epidemiology is the study of how disease is distributed in populations, and the factors that influence or determine this distribution. Although epidemiological studies are superior to animal toxicity studies in