UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC. ,	)	Docket No. 40-8943
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal for the ===	)	
In Situ Leach Facility, Crawford, Nebraska)	)	May 1, 2015

EXPERT OPINION TESTIMONY OF LINSEY MCLEAN

I, Linsey McLean, do hereby swear that the following written testimony is true to the best of my knowledge:

I. Basis for Testimony as Expert in Field.

As an environmental biochemist working with toxic exposures in both animals and humans for the last 40 years, I have collected the largest databank for hair analysis of metals and minerals of anyone in the world since 1977. This databank follows the continuing increase in environmental toxins in air, water and food residues over the last 50 years, and correlates with disease and health compromise symptoms and syndromes. To date, I have one Canadian and 7 U.S Patents for products and protocols addressing health compromises from environmentally driven diseases in both humans and animals, including one for the only diet protocol that has ever earned a U.S Patent. This diet program resulted from my research from the 1970's, 1980's and 1990's, and underlies all the popular and effective diets of today featuring low carbohydrate, high protein, and high monounsaturated healthy vegetable oils, including the Atkins Diet, the South Beach Diet, the Zone Diet, the American Diabetes Association Diet, the Mediterranean Diet, etc. The foundation of this revolutionary approach is designed to fuel biochemical energy pathways while supporting compromised biochemical pathways, including hormone pathways, and also addressing detox of the interfering environmental chemicals, so that normalization of biochemistry is achieved. I have served in Michigan as an expert witness in state courts in environmental pollution and dumping cases and as expert witness in South Dakota in state and federal (NRC) hearings in the Dewey Burdock case for ISL uranium mining. My complete CV is attached.

II. Expert Opinions and Testimony Concerning Contentions #A, 12.

Opinion: [**contaminants associated with the current mining operations may produce non-radiological health effects]**
Basis: Inorganic forms of minerals, especially selenium and uranium, as well as other heavy metals, which consistently test high in aquifers post mining, have shown to be toxic to living systems of plants, animals and humans in very low levels. Uranium toxicity at low levels has shown in population statistics of exposed population such as Native Americans on contaminated and exposed reservations downwind and downriver from old exposed uranium mines to be more predisposed to chronic conditions such as: metabolic syndromes, diabetes, behavior and sleep problems, obesity and heart disease, fertility, and morbidity and mortality compromises. These are non-radiological effects of uranium discussed, in that uranium as a metal actively incorporates itself into the biochemistry of the body. The radiological effects are another subject, not involving the actual chemical reactions such are described here.

Reference
Heavy metal uranium affects the brain cholinergic system in rat following sub-chronic and chronic exposure

"Previous studies have shown that uranium is present in the brain and alters behavior, notably locomotor activity, sensorimotor ability, sleep/wake cycle and the memory process, but also metabolism of neurotransmitters. The cholinergic system mediates many cognitive systems, including those disturbed after chronic exposure to uranium i.e., spatial memory, sleep/wake cycle and locomotor activity."

Helene Bensoussan[a], Line Grancolas[a], Bernadette Dhieux-Lestaevel[b], Olivia Delissen[b],Claire-Marie Vacher[c], Isabelle Dublineau[a], Philippe Voisin[a], Patrick Gourmelon[a], Mohammed Taouis[c], Philippe Lestaevel[a]

Basis:
Uranium is known to travel through the blood to virtually every tissue and organ system in the living body through active transport by blood. It will reduce and for solid precipitates in the hard tissues of the body like bone and also cause kidney stones and kidney disease and the precipitates enlarge with time and chronic exposure. Binding with bicarbonate in the body will also compromise the body's ability to neutralize acids, predisposing to gastric ulcers as well as various muscle pains, cramps and spasms. Highly acidic bodies with compromised acid neutralization abilities, such as contamination with compromising uranium ions, will have higher agitation levels and volatility of behavior. Uranium ions in the liver will compromise blood sugar regulation, causing increased cravings for sugars in the diet, leading to diabetes, metabolic syndromes and obesity, as carbohydrate metabolism is compromised. Further, as blood sugar lacks internal regulation, alcohol and drug use is elevated in statistics, as the body struggles to "just feel good for a little while". Increased cancer rates are observed with uranium exposure as well as

reproductive toxic effects with DNA breakage observed. Compromise to the connective tissues of the body, that cover virtually every surface in the entire body, produce autoimmune diseases such as crippling Lupus. This is exactly what we are seeing in population health statistics on the reservations affected. Further, the toxic effects of uranium are greatly enhanced in the presence of calcium ions, which are known to be generated in ISL mining as well as in runoff waters of the Rocky Mountains over old uranium open pit mines. The Rocky Mountains are high reservoir of calcium carbonate, so ISL mining waters containing uranium as they are known to do, will have even more toxic effects in synergy than what would be expected and predicted of each separately.

Reference:
Medical Effects of Internal Contamination with Uranium
Croatian Medical Journal v.40, n.1, Mar99 Asaf Durakoviæ
Department of Nuclear Medicine, Georgetown University School of Medicine, Washington D.C., USA

"Uranium as a heavy metal is of particular importance as a complex of uranium and bicarbonate ions, which increases the solubility of uranium in serum. This compound is rather insoluble in water due to the complex ion formation between uranium and bicarbonates. This mechanism determines the transport of ultrafilterable uranium from the sites of contamination to the tissues and target organs (8). In blood, the uranium-bicarbonate complex establishes an equilibrium with non-filterable protein-bound uranyl ions, with 60% of uranium bicarbonate-formed and 40% protein-formed (9). In other studies, 74% of uranium in blood was present in the inorganic compartment of plasma, 32% was protein-formed, whereas 20% was associated with red blood cells (10). Uranyl salt complexes with bicarbonates are less stable than uranous salt complexes. Reduction of uranium in plasma is not probable, while the uranous salts can be reduced in the intracellular environment (11). Uranous (IV) retention sites are the bone and kidney, whereas uranyl (VI) ions accumulate in the liver and spleen prior to their redistribution in the renal and skeletal system."

"Each of the uranyl ions are complexed by two phosphate ions on the surface of bone crystals, with simultaneous release of two calcium ions. The uranous ion produces a toxic effect on the living cells by inhibiting the processes of metabolism of carbohydrates by the inhibition enzyme systems. A uranyl ion replacing a magnesium ion binds the ATP molecule to hexokinase. ATP-uranyl-hexo- kinase complex blocks the release of phosphate to glucose, inhibiting its first step of metabolic utilization with non-metabolized glucose in the extracellular environment (12). The toxic effects of uranium were shown to be enhanced by the administration of calcium (33). The effects of uranium on the nervous system have been described as paralysis of the hind legs, blindness, and loss of coordination in rabbits in the terminal phase of intoxication (52). Most recent studies indicate significantly higher prevalence of malignant

> diseases in uranium workers (59), with increased mutations in underground miners (60) and connective tissue disease, including lupus erythematosus (61). Reproductive toxicity of uranium in a recent Chinese study includes chromosome aberrations in spermatogonia, causing DNA alterations in the spermatocytes and strand breakage in sperm (62)."

Basis:

All metals/minerals have a relationship to each other in Nature. They balance each other. Too much of one will have a negative effect on the other. For good health, they all need to be in proper balance. Heavy metals generated from mining are many, and will compromise many essential minerals for health. When one mineral or metal is too high, it will exert a repressive effect upon its counterpart metal or mineral, causing a deficiency or imbalance. Since minerals are known to fuel enzyme systems in the body, and the living body is dependent upon enzymes for life itself, compromise of any enzyme system can cause severe health consequences and even death. The toxic heavy metals generated in ISL mining are shown in an overlay to accurately depict the interference of those toxins on the natural system and their impact to all living things, even plants. See slides 1-6

Inorganic salts of metals most prominent in aquifers, also have different toxicities, and any monitoring of aquifers should include speciations of these different forms so that proper toxicity evaluation can be done. Simply giving the absolute levels of a metal does not tell the whole story. All metallic "salts" are not equal. They can have different solubilities, different melting points, different Ph, different conductivity affecting the central nervous system that relies on electrical signals, and totally different chemistry within the living body. Further, any discussion to the general lay public needs to distinguish between a chemical metallic salt and ordinary table salt, that the public is led to believe will be created as "salt" in a mined aquifer. Slide 7 shows the many species/chemical forms that a metal can take upon exposure to oxidation/reduction reactions typical within an ISL mining aquifer. Typically, speciation testing, even if monitored by the mining company, is not made available to the public.

The difference between inorganic and organic compounds:
Organic compounds always contain carbon, while most inorganic compounds do not contain carbon. Also, almost all organic compounds contain carbon-hydrogen or C-H bonds. Organic chemistry is "The Chemistry of Life". Metals in an inorganic form have significantly different chemistry in the living body from organically bound minerals Organic forms of uranium as well as other toxic metals have also been shown to exist in mining areas and they are not known to be recoverable by the ion exchange method of ISL recovery, since it is already bound organically and will not bind to the organic synthetic resins. Organic forms of any heavy metal are known to be much more toxic and much more bioavailable, so that they are able to penetrate the lining of the digestive tract much

easier than ionic and inorganic salts that are blocked by their electrical charges. Organic metals have their electrical charges spread over the organic ligand they are bound to, so that they act as a "chelate", something that the health industry does to minerals to significantly improve absorption of essential minerals, and also make them much more able to enter into direct biochemical reactions in the living body. Organically bound metals under this circumstance, and there is plenty of organic carbon naturally existing with ISL mining sites to make this a complication, will continue to increase in the waste water of the ISL mine as they are **not recoverable, adding to the metal burden of the wastewater and also the toxicity of such beyond what would be it the metals remained in an inorganic and ionic form.**

Reference:

Arabian Journal of Chemistry
Volume 4, Issue 4, October 2011, Pages 361–377

Problems with Ion Exchange in Water Purification

"Ion exchange is another method used successfully in the industry for the removal of heavy metals from effluent. An ion exchanger is a solid capable of exchanging either cations or anions from the surrounding materials. **Commonly used matrices for ion exchange are synthetic organic ion exchange resins. The disadvantage of this method is that it cannot handle concentrated metal solution as the matrix gets easily fouled by organics and other solids in the wastewater.** Moreover ion exchange is nonselective and is highly sensitive to the pH of the solution." (Kurniawan et al., 2006).

Basis:

On the other hand, binding natural essential minerals to organic molecules will make them more bioavailable as well, and so much better able to enter the living body. We use that chelation process to enhance nutrition for essential minerals.

25 controlled studies by different authors in five different countries adverse array of data is presented. These data validate the effectiveness of mineral nutrients presented as amino acid chelates when compared with the ionic forms derived from the inorganic salts. These studies further support the results of numerous laboratory experiments showing increased absorption, assimilation and reduced toxicity of the forms of minerals chelated to amino acids. With little cost and effort animals can be supplemented with amino acid chelates which will promote, with little risk of overdose, a fuller genetic potential achievement as far as mineral requirements are concerned. Results of this supplementation are reflected in increased growth, immunological integrity and more consistent reproduction increased ovulation and conception after first service as a result of increased bioavailability of these

chelated forms. See Slide 8

Reference:
Chelated Minerals in Animal Nutrition
Rajendran, C.Kathirvelan and V.Balakrishnan, Madras Veterinary College, Chennai, INDIA

Basis: **The Jeckyll and Hyde personalities of minerals**
Even the minerals that we consider necessary for the living body will have different biochemical actions and tissue and organ destinations in the living system. Common case in point: selenium. Selenium is known to have wonderful health effects, preventing cancer, converting the storage form of the storage thyroid hormone T4, to the active form T3 by virtue of fueling an enzyme glutathione peroxidase. This biochemical reactions is absolutely essential to life. Glutathione also doubles as the most powerful antioxidant in the body. Inorganic selenium, as is the form generated in ISL mining, is known to cause birth defects of the highest severity. However, in the inorganic state, selenium as a consequence of mining, is severely toxic, producing severe deformities. The higher evolved animals above micro organisms are not able to convert quantities of the inorganic forms of minerals, even essential ones like selenium, into the bio compatible organic forms. See slides 9-17

Basis: **Bioaccumulation of organified heavy metals rises quickly in the living systems and the environment, rising up the food chain.**
Elemental inorganic forms of metals and minerals are “organified”, bonded with carbon compounds to become organic forms by micro organisms, which are then eaten by simple life forms, which are then eaten by higher animals, and so on, all the way up to man and other top predators at the top of the food chain. As these metals and minerals pass from one body to the next, they are known to concentrate as they move up, with humans and other top predators then suffering the worst consequences from the highest concentration in their tissues and organs. There can be formed many different kinds of organic metal compounds, however, all are not equally bio essential, some are even more toxic as the living body cannot convert them. This will depend on which micro organisms are organifying the metals into which compounds. See slides 18-21

Basis: **Selenium is a poorly regulated heavy metal, and difficult to regulate as far as toxicity and allowable levels are concerned, because of the myriad chemical forms that it can exist in, each with different toxicity.** The same can also be said for

every other toxic metal as well as nutritional metal. The Jeckyll and Hyde personalities of these elements is a very real thing in the natural world. Slide 22 shows the incongruencies between actual toxicities of some chemical forms of selenium and the regulatory levels. Most toxicity level charts fail to take into consideration the chemical forms of metals and minerals, which is absolutely critical in assessing any toxicity status. Care for patients suffering from selenium poisoning is usually aimed at treating symptoms. There is no specific antidote or treatments for selenium poisoning.

Reference:**Upper Human Limits for All Minerals and Metals**
http://iom.edu/Activities/Nutrition/SummaryDRIs/~/media/Files/Activity%20Files/Nutrition/DRIs/ULs%20for%20Vitamins%20and%20Elements.pdf

Basis: **Arsenic is another major pollutant.** Unlike selenium, which has a value in certain chemical forms as a health and life biochemistry promoter, arsenic has not been found to have any health value outside of its use as a parasiticide, and even that use can have toxic consequences. Slide 23 shows the major health effects of arsenic exposure.

Arsenic opposes iodine on the mineral wheel of life, and will cause a physiological iodine deficiency by its opposing actions even if there is enough iodine in the diet to counteract general deficiency. Such is the case with all opposing metals and minerals of nutritional minerals. This is how things work in Nature and the living body. Metals like arsenic have their own set of compromising chemistries, but the opposition and interference chemistries of opposing metals and minerals presents a whole new set of pathways for health compromise, independent of the individual roles of the individual metals in actual biochemical reactions. So, but its opposing action on iodine, arsenic can precipitate a whole hypothyroid overlay on the living body, complete with all the health compromises that a hypothyroid body will manifest. Slide 24 shows the different LD 50 doses for different chemical forms of arsenic. LD 50 represents the level at which 50% of the animals are killed from the toxin presented. So this again shows the importance of different toxicities of different chemical forms. Slide 25 shows the comparison of the toxicity of arsenic relative to other common toxins. Slides 26-30 show arsenic effects in humans.

There is no specific treatment for chronic arsenic poisoning. Once it has been identified further exposure should be avoided. Recovery from the signs and symptoms may take weeks to months from when exposure is stopped. In particular, effects on the nervous system may take months to resolve and in some cases a complete recovery is never achieved.

Basis: **Epigenetics, a newly recognized toxic compromise of DNA by heavy metals.** Epigenetics is a new study looking at how heavy metals and other environmental toxins can and do affect the gene expression of DNA to cause potentially serious ill health

compromises, even death. DNA is actually a set of switches which are found to be controlled by chemical signals from the cell membrane of each cell, which are generated in response to the cell membrane's sensing of the environmental characteristics in the fluid surrounding it. Every living cell is actually floating in a body fluid called lymph. If the cell membrane senses that something is wrong, it sends a chemical signal to the cell nucleus and DNA there to adjust by turning on or off certain genetic switches. This is the living body's way of adapting to its surroundings for survival. This is evolution in progress.

Heavy metals have been found to both up regulate and down regulate DNA switches, and these switches tripped by epigenetic toxins can remain tripped into up to 5 generations hence, even if the original cause or toxin has been removed in the first generation. The implications for health and humanity for future generations considering epigenetics is mind blowing. Slides 31 -35 tell the story of epigenetics and the impact on DNA expression, all the way to cancer.

Basis:

Heavy metals also act as xenohormones and hormone disruptors in the living body.

Our hormones are all stereoisomers, meaning atoms are arranged differently in 3 dimensional space, and are subject to the toxic effects of xenohormone environmental toxins. Heavy metals have been shown to act as xenohormones, entering into the cellular receptor sites and skewing the hormone biochemical pathways for Estrogen, Testosterone, Progesterone, Cortisol, Pregnenolone, Thyroid, DHEA, Insulin and more. Since hormones are key initiators, regulators and intermediary metabolites of virtually every biochemical reaction in the living body, the protection of their integrity is crucial for their actions. Heavy metals, environmental chemicals and industrial chemical wastes can act as "xenohormones", and interfere with natural hormones, enzymes, etc., and cause cancer and other severe ill health compromises.

Further, heavy metals are known to be "xenoestrogens", a hormone mimic of estrogen, the female and growth hormone. Estrogenic toxicity causes cancer, skin lesions, obesity, fertility problems, accelerated aging, liver problems, learning problems, mood disorders, metabolic syndrome, blood sugar irregularities, blood fat irregularities, increase in breast tissue and size in both males and females, smaller or even undeveloped male genitalia and higher anger and anxiety responses to daily life situations. Mineral imbalances caused by high levels of toxic heavy metals themselves, also are known to cause hormone imbalances of insulin, thyroid, testosterone, progesterone, estrogen and cortisol.

We see those very problems exemplified in the most toxic areas of the world, and in increasing statistics overall in the world, as environmental pollution moves around the world. All of the heavy metals studied so far, that are common exposures to man, have shown to be "xenoestrogens", including those that are generated from the rock strata at Crowe Butte. The increase in obesity of animals and humans over the last several decades is directly correlated to the increase of environmental toxins that are known to be fat soluble and deposited in body fat, including heavy metals.

Reference: J Toxicol Environ Health B Crit Rev. 2009 Mar;12(3):206-23. doi: 10.1080/10937400902902062.

The effects of metals as endocrine disruptors.

Iavicoli I1, Fontana L, Bergamaschi A.

Abstract

"This review reports current knowledge regarding the roles that cadmium (Cd), mercury (Hg), arsenic (As), lead (PB), manganese (Mn), and zinc (Zn) play as endocrine-disrupting chemicals (EDCs). The influence of these metals on the endocrine system, possible mechanisms of action, and consequent health effects were correlated between experimental animals and humans. Analysis of the studies prompted us to identify some critical issues related to this area and showed the need for more rigorous and innovative studies. Consequently, it was recommended that future studies need to: (1) identify the mechanisms of action, because at the present time only a few have been elucidated-in this context, the possible presence of hormesis need to be determined, as currently this was reported only for exposure Cd and As; (2) study the possible additive, synergistic, or antagonistic effects on the endocrine system following exposure to a mixture of metals since there is a lack of these studies available, and in general or occupational environments, humans are simultaneously exposed to different classes of xenobiotics, including metals, but also to organic compounds that might also be EDCs; (3) assess the potential adverse effects on the endocrine system of low-level exposures to metals, as most of the information currently available on EDCs originates from studies in which exposure levels

Our hormones are all stereoisomers, meaning atoms are arranged differently in 3 dimensional space, and are subject to the toxic effects of xenohormone environmental toxins. Heavy metals have been shown to act as xenohormones, entering into the

were particularly high; and (4) assess the effects on the endocrine and reproductive systems of other metals that are present in the general and occupational environment that have not yet been evaluated."
PMID: 19466673 [PubMed - indexed for MEDLINE]

Basis: **Heavy metals are also known to denature protein and negate the biochemical activities of protein based enzymes and hormones, as well as cause effects in skeletal muscles.** Protein makes up a full 90% of the dry weight of the living body. Any living body, any species. Protein is an organic compound composed of long chains of amino acids. Each protein has its own distinct combination of amino acids and also its unique three dimensional shape, and it is the shape that gives it its unique biochemical activity, not simply the chemical formula of its amino acid composition. **This is the most important concept in protein, hormone and enzyme biochemistry.**

Denaturation is a process in which proteins lose their three dimensional structure/shape which is present in their native state, causing them to unwind and deform, by application of some external stress or compound such as a strong acid or base, a concentrated inorganic salt, an organic solvent (e.g., alcohol or chloroform), radiation or heat. If proteins in a living cell are denatured, this results in disruption of cell activity and possibly cell death. Denatured proteins can exhibit a wide range of characteristics, from conformational change and loss of solubility to communal aggregation to form a solid.

Heavy Metal Salts:

Heavy metal inorganic salts act to denature proteins in much the same manner as acids and bases. Heavy metal salts usually contain Hg+2, Pb+2, Ag+1 Tl +1, Cd+2
and other metals with high atomic weights. Since salts are ionic they disrupt salt bridges in proteins. **The reaction of a heavy metal salt with a protein usually leads to an insoluble metal protein salt, meaning that it forms a solid and becomes inactive biochemically.**

A common example that we all understand and that is epidemic in the human and pet animal population today, is that of insulin. Insulin is a three dimensional folded protein that acts also as a hormone, regulating blood sugar but escorting glucose in

the blood into the tissues for storage. If the insulin cannot accomplish this process, then the blood sugar rises to dangerous levels and the patient is diagnosed with Diabetes.

Non-Insulin Dependent Diabetes, or Diabetes Type 2, is the result of such a compromise in the body, with the insulin not able to perform its designated function. It is also called Insulin Resistant Diabetes, because simply giving the affected patient more insulin does not cure the problem. Typical blood testing of insulin reveals the presence of adequate insulin or even higher than normal levels, but conventional blood testing is not capable of viewing the actual three dimensional shape of the molecules to properly asses their actions or lack of. So we typically see the Type 2 diabetic having both high blood glucose along with high insulin levels that are not working effectively. The insulin has been denatured in the blood, and any new insulin that would be still functional when administered to the type 2 diabetic with toxic blood sporting effective levels of some denaturing toxin, will just further deform any new and functional insulin given. Such is the naming of "Insulin Resistance".

The same scenario is commonly born out with thyroid testing and other natural hormones such as estrogen, testosterone, progesterone, DHEA, cortisol, pregnenolone, etc. We call this scenario in medicine "euthyroid hypothyroid" for thyroid, and appropriately such for the other hormones, where the blood levels show normal levels but the patient manifests hypo hormone symptoms, because the hormones present have been denatured and rendered ineffective. This is a serious problem for medicine today. This is a serious problem in assessing the real toxicity of any environmental toxin that has been shown to denature protein, such as heavy metals. Conventional blood testing does not accurately reflect the true health compromise of the sick individual. Slides 36 - 37 show how proteins are formed and then folded into their three dimensional shapes and then subsequently unravelled and deformed by denaturing agents. Slide 38 shows the hormone insulin with its characteristic folded nature, that is unfolded in Type 2 diabetes by denaturing agent exposure.

Opinion: [impacts of selenium on humans and wildlife if Crow Butte uses land application of mining wastes]

Basis: **Heavy metals, most notably: Selenium, Molybdenum and Arsenic will be generated in soluble forms that are highly toxic to all living things, and are able to be concentrated even further by bioaccumulation up the food chain.**
Reclamation of the affected land is not physically or economically feasible.The land application for wastewater is destined for environmental contamination that

will never be able to be remediated. Heavy metals never degrade into harmless substances. Those lixiviant solubilized toxic heavy metals, will eventually migrate into groundwater aquifers or surface water via streams, floods, melting snow runoff and storms.

No ISL mines have ever have proven to be safe and free of excursions, or been able to be properly decommissioned with the mined aquifer restored to baseline chemistry levels, so that the water is drinkable in quality.

Humanity has continuously failed to clean up our mining messes throughout history, as evident from all the superfund sites of total and complete loss of any use all over the country and the world, not to mention the over 10,000 other old uranium mines that should be super funds and are not, due to lack of funding for remediation/burial. It is likely that this mine will join the current open pit mines that should be superfund right next door.

The more dangerous the mined materials, the more toxic the residual mess left. In this case, mining of uranium, a toxic heavy metal in itself, also brings an additional risk of radiation from radon gas and lixiviant solubilized radioactive heavy metals of vanadium, thorium, strontium and radionuclides.

Reference: Large amounts of contaminated wastewater are generated, according to a report on ISL mining prepared for the Larimer County Commissioners by The Larimer County Environmental Advisory Board, in WY, they say:

“Due to the nature of ISL mining, quite large volumes of wastewater are created, which are often highly saline and contain toxic levels of heavy metals, process chemicals, and radionuclides. Excess ISL process water that is not re-injected is typically either directed to an evaporation pond, or injected into a deep disposal well to an aquifer below the uranium deposit and domestic aquifers.”

Slides 5 and 6 show the Mineral Wheel - a graphic of how minerals and metals interact with each other. You can see that, following the arrows from one to another, that an excess of one will create a deficiency of another. This is important in the health of all life, as minerals both fuel and direct enzymatic biochemical reactions in the living body. When high levels of heavy metals offset and upset the biochemistry of the living body, severe compromises to health are set in motion, including hormone imbalances. Heavy metals will not only create deficiencies of essential minerals but also exhibit toxicity by their very presence in the living body. Thus they are doubly toxic.

Looking at just one of those toxic heavy metals, selenium, well known as a common mining pollutant in Crowe Butte and elsewhere, we find that according to studies done at the Smith Ranch and the Highlands Uranium Mine in Converse County, Wy, selenium was found to bioaccumulate in the environment and wildlife of the area where in situ wastewater was used to irrigate grasslands. In this case, the in situ wastewater was applied to grasslands as irrigation water. http://link.springer.com/article/10.1007/s00244-001-0037-y#page-2

In this study, mean selenium concentrations in grasses, grasshoppers, red-winged blackbirds eggs and livers were 5.8 to 30 times higher at the study area than at the reference site. Elevated selenium collected from soil, water, and wildlife demonstrate that selenium is being mobilized and is bioaccumulating in the food chain. This can eventually affect livestock grazing in the area and can then enter the human food chain.

Fish and aquatic organisms are especially sensitive to selenium levels and grasshoppers and other insects, salamanders and crayfish are key parts of the food chain at risk.

Slides 9 and 10 show fish affected by selenium toxicity.

A low concentration of selenium in water has the potential to increase by several orders of magnitude by the time it reaches fish and wildlife. For example, a water concentration of 10 ug/L (micrograms per liter or parts-per-billion) can increase to over 5,000 times that amount in fish tissues. Bioaccumulation causes otherwise harmless concentrations of selenium to reach toxic levels. This same principle applies to other heavy metals as well.

slides 18-21 show a graphic of how bioaccumulation works. The substance that exists in a low level amount in the environment, that was formerly thought to be so low as to be safe, is taken up by small and simple organisms such as algae, then eaten by animals, which in turn are eaten by other animals up the food chain, and the substance is further concentrated as it travels up the food chain, increasing its toxicity. Man, as the top predator, will suffer the most from bioaccumulation as we eat the animals in the food chain below us.

Although fish do take up some selenium directly from water, most of it comes from their diet. Therefore, in order to protect fish from selenium poisoning it is essential to keep waterborne selenium below levels that cause bioaccumulation in the food chain (Lemly and Smith 1987).

Selenium can exist in many chemical forms, and some forms are more toxic for the amount of selenium exposure than others. Symptoms of selenosis, selenium toxici-

ty, include a garlic odor on the breath, gastrointestinal disorders, hair loss, sloughing of nails, (hooves and claws in animals), fatigue, irritability, thyroid compromise, thyroid chemistry compromise, and neurological damage. Selenium in certain chemical forms, is not only non-toxic but absolutely essential to life. It fuels the enzyme that converts T4, the storage form of thyroid hormone to T3, to the active form, that regulates the speed of all biochemical reactions in the body at the cell level. Extreme cases of selenosis can also result in cirrhosis of the liver, pulmonary edema, and death.

Slide 11 shows horse hooves affected by selenium toxicity

Slide 12 is a picture of sheep with selenium poisoning and cattle hooves

Slide 13 shows the mutagenic birth defects effects of selenium on ducks that had access to evaporation and holding ponds in mining.

The same result of toxic bioaccumulation occurs for other known pollutants and products of ISL mining, such as arsenic. So that everything stated above for selenium can also be said for arsenic, manganese, chromium, copper, vanadium, and other heavy metals.

Slides 26 - 29 shows cancer and lesions from chronic arsenic poisoning in humans

Slide 30 shows blood abnormalities from selenium toxicity
Metals cannot be broken down to other elements in Nature or the living body, and in fact, toxin exposure in continuous low levels, formerly thought to be safe, have now been shown to have additive or synergistic effects, where the end effects of a combination of toxin exposure produces more severe health compromises than those that would be expected from each toxin. The common example is that 2 +2 now equals 8. Since different chemical forms of minerals and metals can and do exist, and some are more toxic than others, and travel up the food chain at different rates. Different chemical forms of minerals and metals target different organs and tissues of the body.
Additionally, each individual toxin is shown to enter the body at levels under the body's detoxification radar of liver detoxification, thus allowing toxic levels of the pollutant to build up over time, until the body becomes so sickened that it cannot help itself anymore in a detox and elimination protective method.

Arsenic, in particular, is extremely dangerous in the world today, and especially North America, because arsenic opposes iodine on the mineral wheel, meaning that high arsenic

causes iodine deficiency. Current research has shown that we need far more iodine than we thought we did for health, and we are not getting it in food or water, even as we used to decades past, when iodine was used in food processing and water purification.

Arsenic has been rising in our environment and food supply because of the legal dumping of it into commercial fertilizers from mining and ore smelting waste since 1976 when it became legal to do so. In the 1980's President Reagan increased to legal limit of arsenic in public drinking water because the levels were rising so high, and arsenic is both difficult and expensive to remove from water, as mining reclamation efforts have shown.

Mother Nature, of course, does not necessarily agree that so much arsenic is safe! Arsenic compromises thyroid. Thyroid disease has escalated epidemically in the last 50 yrs since iodine was reduced in our food and water supplies. And today, as relevant for accelerated aging, each generation is not expected to live as long as its parents, and higher and higher statistics of formerly "old age" ailments are evident in younger and younger segments of the population, severely compromising our health care.

Reference: **Combined Toxic Exposures and Human Health: Biomarkers of Exposure and Effects**
Int. J. Environ. Res. Public Health 2011, 8, 629-647; doi:10.3390/ijerph8030629

These toxic metals will be concentrated in the area of waste water discharge for time immemorial and due to the large volume of wastewater generated and also the large surface area contaminated, no effective and safe economical method of remediation and reclamation of the land's original purpose is possible. Application of wastewater to grasslands from this uranium mine is not a good idea, and not a safe and efficacious solution for disposal of this highly contaminated waste water. The subsequent plants grown, if they are able to grow at all from the toxicity, would be far too contaminated to be used for any feeding.

Substantial disposition of sediment in stream or lake beds, landslides, or water pollution cannot feasibly be prevented;
Containment of toxic wastewater load is not feasible in a leach pond designed to be large enough to be a lake bed, contrary to a plan to fence out Nature. No fence will last the lifetime of the toxins being contained here: ie; the lifetime of radiation left behind and accumulation of heavy metals that never die or degrade, in sediments of a pond. It is not possible to adequately fence off Nature. Fencing plans are to fence off mammals, however, there is no fence for the rest of Nature, insects and other small crawly things, small mice, salamanders, snails, etc., at the bottom if the food

chain, that would leave the pond and be eaten by their predators, to have their toxins then bioaccumulate up the food chain.

Seasonal weather changes bringing heavy rains, winds, blizzards and floods will cause the borders of the pond to be overrun, taking toxins away from the pond, toward streams and rivers, and giving access to Nature, the environment and wildlife. Further, seasonal drying in summer and drought conditions will allow exposure to the winds of dried sediments on the pond's edge, adding to air pollution which can be carried for miles. Migrating birds and other animals will carry toxins to far away places, while it damages their bodies for survival, and contaminates game birds that are hunted and eaten by man.

Further, with the high drainage capabilities of areas of Crowe Butte, such that domestic leach beds for septic systems often drain too fast, this water with its toxins will permeate the Earth and eventually contaminate the waters below. This is how Nature works to recharge its aquifers, after all. And gasses produced like radon, will be taken by the wind with other by toxic byproducts yet to be seen.

The problem with ponds

1. Ponds are shallow design, not more than a few feet deep. This allows for more contact between the highly chemically active waste water and the plastics in the liners, facilitating faster degradation. And all plastics do degrade over time, even without this chemical exposure. The high levels of oxidizing chemicals will speed degradation dramatically. This is what these chemicals do and why they are used in the ISL process to degrade rocks.

2.The plastics used in the liners are polypropylene and polyethylene, common plastics we use every day. These plastics are so easily degraded that they are the principle plastics used in the food and bottled water industry and easily recycled by adding chemicals to degrade and disintegrate, and hence the ones we recycle.

The warranty by the manufacturer is only 1 yr for the polypropylene and 2 yr for the polyethylene, and the project is supposed to last 20 yrs. And the strips of plastics will be bonded together by seams of heat and or glue, and these have been shown in other EPA tests to leak.

3.The plasticizers that are integral in all plastics to give them their softness and pliability, are well known endocrine disruptors and hormone mimics, and also are well known to leach into foods. Hence the warnings of plastic bottled juices, foods and waters.

When these plasticizers are leached from the plastics, the plastics become brittle and will break and then leak. I would expect leaks fairly quickly in the these ponds because of the

contact with these highly active oxidative chemical waste waters facilitating that leaching of plasticizers and degradation.

The clay liner underneath will not be impervious to the leakage, as we have found with clay pits of old that are now deemed superfund sites. Clay leaks too.

I have just given numerous reasons that conditions for land reclamation and prevention of contamination cannot be met with Crowe Butte's mining activities.
None of this data has been considered by NRC in its environmental assessment.

The moral of the story is that once you severely contaminate an environment with radiation and heavy metals, it cannot be taken back. The initial financial rewards enjoyed for a relatively short time become horribly costly in the end, much more so than the initial rewards.

And science now understands that exposure of just one generation of individuals, will have their genetics impacted in a negative way for the next 5 generations, even if that individual is removed from the contamination. This is HUGELY significant! This means that birth defects from environmental toxins can last up to 5 generations afterward.

Contamination of our water, land and air with radiation and toxic chemicals released in uranium mining and processing cannot be taken back...not in our lifetime, nor the lifetimes of the next 5 generations. In fact, it cannot be taken back at all.

Civilization has been shaped over time by science and scientific discoveries. Indeed, this is how we grow and develop as humanity. New observations by man are incorporated into the standard paradigm which change our world views, and shape and direct our actions for the future. We learn from our mistakes, or are supposed to.

When new observations come into conflict with the standard paradigm, there is always outrage, resistance and denial, as the status quo is challenged. However, for man to progress forward, these new observations must be incorporated into our learning curve so that civilization can progress forward. We must keep learning about our environment, our surroundings and our place in it, to survive, maintain and improve our quality of life on Earth.

In decades past, we thought that butter was the best treatment for burns. In fact, even hospitals put butter on burns. It wasn't until an oil tanker burned and sank in the north Atlantic, leaving the crew with burns up to 80% of their bodies and floating in the cold ocean for 14 hours until help arrived, that we discovered that cold

water was the superior treatment for burns. When the crew was plucked from the cold ocean water, they were in remarkable shape. This new discovery by tragedy, changed our paradigm of burn treatment forever. Yes, it caused the expected denial, resistance and outrage by the traditionalists, but further studies comparing different treatments of burns proved the new discovery correct, and a paradigm shift was accomplished.

Today, with ISL mining, we are now seeing the same traditionalist beliefs prevailing here, however history has shown us that ISL mining cannot be contained, aquifers cannot be restored to baseline, and the mining toxic wastes cannot be disposed of in a safe and economical way. So, we professionals here testifying for you today, from various fields of expertise, are giving you the latest research and information for you to use, for the opportunity for you to right a grave wrong, to upgrade our paradigm for the good. Understanding that those who came before you, permitted ISL technology with the belief that mining in a totally reduced zone, a condition that other areas exhibit, would safely secure any excursions, that they would just go out and hit the reduced zone and turn back into rock and be contained for safety. However, history has shown us otherwise. Now, with the experience of history and the research we have given you, you have the opportunity to upgrade our mining scientific paradigm and uphold your agency's commitment to guarding the environment and safety of the American people with your oversight, that is regulating agency mandate, and deny this permit.

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Inventors: Harvey H. Ashmead, H. Dewayne Ashmead, Darrell J. Graff

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Int. J. Environ. Res. Public Health 2011, 8, 629-647; doi:10.3390/ijerph8030629 **Combined Toxic Exposures and Human Health: Biomarkers of Exposure and Effects**

http://www.diabetesandenvironment.org/home/mech/genes **Epigenetics and gene expression**

Pursuant to 10 CFR 2.304(d) and 28 USC 1746, I declare under penalty of perjury, that the foregoing is true and correct to the best of my knowledge and belief.

Signed in _____Rapid City, SD_____, _____, on _____April 30, _____, 2015.

Linsey McLean_____
LINSEY MCLEAN

Curriculum Vitae

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EDUCATION

1967-1972 University of Michigan, full paid academic scholarship, AB in science with double major of biology and chemistry

1974-1975 Michigan State University and Eastern Michigan University to complete specialty in Clinical Microbiology and Clinical Mycobacteriology for ASCP (American Society of Clinical Pathology) on full paid scholarship from employer Hurley Medical Center, Flint, Michigan

1975 to present- Continuing education programs as they become available.

WORK EXPERIENCE

1972 to 1973 Clinical Chemistry in private medical lab, routine blood samples and CDC (Center for Disease Control) licensing unknowns.

1972 to 1976 Class 5 CDC Reference Lab (Center for Disease Control) in Clinical Mycology and Mycobacteriology, routine samples with CDC unknowns for licensing in a hospital specialty and research laboratory, Hurley Medical Center, Flint, Michigan

1977 to present- As an active biochemist for Vita Royal Products, Inc.,a company that I founded in 1977. Most of my work is in human and animal research with chronic debilitative diseases. I formulate new supplements for commercial use, blend custom supplements for special cases, consult individ-

ual clients, doctors and veterinarians, and do research and teaching. Research includes extensive and ongoing monitoring of environmental status and its effects on normal biochemistry, monitoring and observing environmental syndromes manifesting in population statistics and how they are changing over the last 50 years, and adjusting nutritional programs to more properly address these pollution interferences on biochemistry.

TEACHING EXPERIENCE

1977 to 1998 –Taught "Biochemistry of Nutrition" classes in nutrition for animals and humans for Mott College, Flint Mi.

1981 to Present- Wrote many feature articles for national magazines including Dressage and Eventing, Equisport, Horse of Kings, Crabbett Arabian, and many others, and the Supplement section for the Whole Horse Catalogue

RESEARCH AND AWARDS

Research work includes neurochemistry with cases ranging from hyperactive children and violent behaviors, to Gulf War Syndrome, neurological affective disorders such as Equine Protozoal Myeloencephalitis, obesity, Type 11 Diabetes and Syndromes X, hormone imbalances, learning disabilities, autoimmune syndromes and diseases, blood sugar regulation, ulcers and leaky gut syndrome, allergy and asthma, clinical depression, chronic fatigue syndrome, chronic infections in both animals and humans as manifestations of environmental pollution. Sports medicine physiology includes high end competition performance horses that perform internationally.

1983 and 1984 Vita Royal Products was chosen as the official supplier of the United States Equestrian Team. Both custom and commercial supplements and feed protocols were formulated for the United States Olympic Team and they won a record number of gold and silver medals, a record yet to be equaled, and in a contaminated environment for athletes, Los Angeles.

1986 -Invited to represent the United States as a Citizen Ambassador in Scientific and Technical Exchange for the People to People Program to New

Zealand and Australia.

1987- Invited to present two research papers to the 10th International **Equine Nutrition** and **Physiology** Symposium, Fort Collins, CO an international scientific professional organization. Both projects won top 10 spots of 1500 entries for oral presentation to veterinarians and university research professors.

"Plasma amino acids/intermediary metabolites in the racing **horse"**.
McLean, LM, Hall, ME and Bederka, JP (**1987**)
This was a study to map the biochemistry of exercise and clinical depression for adaptation to humans.

"Evaluation of serum iron, total iron binding capacity, unbound iron binding capacity, percent saturation of serum ferritin in the equine. "LM McLean, ME Hall and JP Bederka 1987 This was a study to map the biochemistry of anemia as a function of inflammation for adaptation to humans and animals.

1988 – Invited to represent the United States as a Citizen Ambassador in Scientific and Technical Exchange for Communist Bloc Countries.

1991 -Invited to represent the United States as a Citizen Ambassador in Scientific and Technical Exchange for China for Oriental Medicine (TCM) and acupuncture.

1996-After eight years of clinical trials, granted two U.S. Patents in 1996 for environmental biochemistry. One was for the first nutritional diet program for weight loss in morbid obesity, normalizing blood sugar in Type II diabetes and lowering cholesterol using supplements and diet, without drugs, based upon addressing the biochemical compromises in the body from high toxic body burdens and without counting calories. This is significant since there were at the time, over 28,000 diets registered in the U.S., none ever earning a U.S. Patent for efficacy. This research pioneered the low carb diets of today, of which there are many. The clinical trial subjects were all morbidly obese women living in SE Michigan, which at the time and still has, the reputation of the worst statistics for morbidity and mortality in the world. It also has record numbers of toxic landfills and industrial dumpsites as well as air pol-

lution problems that cause the area to regularly fail air quality standards. These people, I felt, were the most environmentally challenged population, with the most severely affected basal metabolism and provided the perfect population to work with. They also had very good medical insurance programs to pay for constant medical lab monitoring testing.

1996- Another US Patent for a liquid composition with both nutritional and buffering abilities, without heavy metals or other potential toxins, to aid the increasing acidity in environmentally affected populations, both human and animal. Also included were ratios of cations to balance abnormal biochemistry from excess ratios of calcium to magnesium.

1999- Wrote an extensive information web site vitaroyalproducts.com for understanding and self help for Environmental Illness in humans and animals

1999- A continuation to the original diet program was awarded a U.S. Patent for treatment and control of all autoimmune diseases including Lupus, Fibromyalgia and Hashimoto's thyroiditis, as well as chronic fatigue and clinical depression. This patent addressed the hormonal interferences of environmental chemicals that mimic natural hormones, and supplementation of natural hormones to aid affected biochemistry. This patent was immediately picked up by ABC NEWS and featured on their web site.

1999- Three more U. S. Patents for additional biochemical formulations. One represents a dry formulation of the liquid Nutrient Buffer; the second addressed "leaky gut syndrome" with a special nutrient supplement blend, and the last defines a soothing, therapeutic bath salt compound.

1999-Christopher Columbus Award finalist, an award given for the best discovery of 1998 for the benefit of mankind.

2000- another patent was issued for "Leaky Gut Syndrome" protocol with application to horses affected by neurological syndromes including Equine Protozoal Myeloencephalitis

2000- present, research continues toward methods of normalizing affected biochemistry in Environmental Illness, and finishing a textbook and lay book called Environmental Health Connections.

2010 - Canadian patent issued for "Leaky Gut Syndrome" protocol with application to horses affected by neurological syndromes including Equine Protozoal Myeloencephalitis

SUMMARY STATEMENT

I will be happy to bring to this table and share 40 yrs of data that I have collected on the degradation of the environment and how it has affected population statistics of morbidity, education problems, quality of life, and why our current nutritional and medical paradigms concerning the above need to be reformed. If the current pollution problems of the world continue to escalate, as I believe they will, then the information that I have collected living and working for over 55 yrs in the infamous "I-75 Industrial Corridor" will become invaluable in setting upgraded nutritional standards and methods of remediation for the rest of the world.