Idaho Code Section 22-101A Statement: Section 22-101A, Idaho Code, provides that ISDA must meet certain requirements when it formulates and recommends rules which are broader in scope or more stringent than federal law regulations. The Rules Governing Dead Animal Movement and Disposal are broader in scope and more stringent than federal law in the following manner: Federal law does not regulate the method and manner in which dead animal carcasses must be disposed of to avoid negatively impacting human health or the environment. The Code of Federal Regulations (CFR) only reference to dead animal carcasses is that they shall not be transported in the same vehicle or container as live animals. The Idaho Legislature recognizes the importance of protecting state natural resources while maintaining an ecologically sound, economically viable and socially responsible livestock industry in the state and has established regulatory benchmarks for which the disposal of animal carcasses shall be done in a manner that shall protect the environment and preserve public health. Therefore, this rule does represent a standard that is broader in scope and more stringent than federal law.

Section 22-101A, Idaho Code, also applies to a rule which "proposes to regulate an activity not regulated by the federal government." This rule may be used to regulate an activity not regulated by the federal government. The following is a summary of additional information required by Sections 22-101A (3) and (4), Idaho Code. Information relating to Section 22-101A (2) has also been provided. The requirements set forth in this rule are based upon best available peer reviewed science and studies and analyses conducted by other states, the U.S. Environmental Protection Agency (EPA), USDA Agriculture Research Service (ARS), and professional and scientific and medical journals. The referenced studies and analyses will be included in the rulemaking record and can be reviewed during the public comment period for further detailed information regarding health effects.

Section 22-101A(2)(a), Idaho Code. To the degree that a department action is based on science the department shall utilize the best available peer reviewed science and supporting studies conducted in accordance with sound objective scientific practices.

The Rules Governing Dead Animal Movement and Disposal describe multiple methods in which a livestock carcass may be legally disposed. This analysis will be limited to those methods that involve decomposition of a carcass in or onto soil within a non-regulated facility, namely burial and decomposition. The remaining methods of carcass disposal described in the rule either are not at risk to endanger public health/environment or are conducted at a facility that is regulated by another state agency. These methods are as follows: Rendering. The rendering process heats/denatures the carcass and tissue so as to inactivate and virtually sterilize all nutrients/pathogens. Following completion of the rendering process, disposal of the remaining tissue is conducted through a municipal waste permit administered by the Idaho Department of Environmental Quality (DEQ). Disposal in an approved landfill allows the carcass to decay within a parcel of land that has been synthetically lined to prevent environmental contamination. These facilities are inspected by and operated under a permit also administered by DEQ. The digestion process is similar to the rendering process in that the bacteria and chemicals in the digester inactivate and sterilize all pathogens harbored by a livestock carcass. Incineration, if performed at an incineration facility, is also a process that is licensed and regulated by DEQ. If a mobile incinerator is used, it would only be implemented by ISDA in the event of a large scale disease outbreak and subsequent depopulation of livestock because the only approved mobile air curtain incinerator in Idaho is owned by ISDA. Disposing of a carcass through burning can only be done by permit issued by DEQ.

For the methods of burial and decomposition, the scientific analysis is as follows: The decomposition of a carcass results in the release of the chemical components of the body through autolysis and putrefaction (Dent et al., 2004). Subsequently, the decomposing carcass can then release a significant pulse of nutrients into the surrounding soil (gravesoil), regardless of the size of the carcass and whether the studies are conducted in a controlled laboratory environment or a field context, resulting in the retention of decomposition products in the soil for a considerable period of time (Carter, 2006). The impact of large herbivore carcasses on soil and vegetation changes has been shown to represent a potentially significant source of nutrient enrichment. Studies conducted in prairie (Towne, 2000) and tundra (Brathen, et al., 2002) environments have demonstrated that the effect of large herbivore carcasses on the surrounding soil and vegetation can be dramatic and still detectable after several years, specifically higher levels of total C, microbial biomass C and total N, 430 days after burial (Stokes, 2009). A significant increase in inorganic nitrogen concentrations was detected in both soil and vegetation surrounding the carcasses. Studies in a temperate forest (Melis et al., 2007) also demonstrated significant increases in nutrient concentrations. Calcium concentrations and pH were found to be higher directly underneath the carcass with a gradient decrease towards the periphery of the decomposition site. This effect was detectable for up to seven years after the death of the animal. Concentrations of nitrate in the soil also differed suggesting a fast turnover of nitrate in the forest ecosystem. The influx of nutrients into soil as a result of large herbivore decomposition has been shown that small carcasses can also infuse the underlying soil with nutrients that are qualitatively and quantitatively detectable (Putman, 1978; Carter and Tibbett, 2006). It has been reported that 20 to 30 mg of organic matter can be released from rodent carcasses (weighing approximately 18 to 25 g) by metabolic processes alone and a further 4 mg of organic matter can leach into the soil and be utilized in the respiration of soil organisms during winter and spring months. This effect is significantly increased during the autumn and summer months when decomposition is more extensive and only 30% of the initial carcass remains after the degradation of soft tissue and loss of organic matter (in contrast to 85% for the winter months) (Putman, 1978). In winter and spring decomposition is slow and incomplete; release of material is entirely due to the activity of microorganisms. After 85 days, little more than 3% of available carrion materials have been expressed. Decay is accompanied by gradual mummification of the carcass. In summer and autumn, carcasses are rapidly colonized by blowflies; within 7-8 days a corpse is reduced to a residue of bones and hair. Some 75% of all materials are released, mostly through consumption and production of blowfly larvae within the carcass (Putman, 1978).

Of the nutrients released during the decomposition process, phosphorus (P) may have the greatest potential for environmental impact. Soil P losses to surface waters are a serious concern in some regions, as elevated P concentrations can cause water quality problems in P-sensitive water bodies. "Non-point" or "diffuse" sources of P, such as agricultural fields that can transport both sediment and soluble P via irrigation/precipitation/snow melt runoff, can be difficult to identify, as their contribution to P loading of surface waters can vary greatly with time and space. The requirements set forth in this rule are designed to protect the environment and public health by regulating the method, manner and timeframe in which a livestock carcass can be disposed of after it has died. This analysis is based upon the best available peer reviewed science and studies and analyses conducted by other states, the USDA-Natural Resources Conservation Service (NRCS), USDA Agriculture Research Service, and professional and scientific journals. Several tools (i.e., Agricultural Policy Environmental eXtender; APEX (Ramierez-Avila et al., 2017, Bhandari et al., 2017), Soil and Water Assessment Tool; SWAT, (Chaubey et al., 2006) including Phosphorus Site Index (PSI) (Weld et al., 2002; Moncrief and Drewitz , 2006) have been developed and used in P management and planning. The referenced studies and analyses will be included in the rulemaking record and can be reviewed during the public comment period for further detailed information regarding the environmental impact of dead animal movement and disposal methods.

Section 22-101A(2)(b), Idaho Code. To the degree that a department action is based on science the department shall utilize data collected by accepted methods or best available methods if the reliability of the method and the nature of the decision justifies use of the data.

The administration and enforcement of the methods of permitted disposal of a livestock carcass in the Rules Governing Dead Animal Movement and Disposal do not identify parameters in which data could or would be collected to verify compliance with the rule. Verification of proper carcass disposal and subsequent enforcement in the event of a rule violation is based upon visual identification of a carcass and/or its method of disposal. The rule does not identify a method to scientifically determine if a carcass has been correctly disposed of, nor would it be necessary, practical or economically feasible to implement such requirements.

Section 22-101A(3)(a), Idaho Code. Identification of each population or receptor addressed by an estimate of public health effects or environmental effects.

The decomposition of carcasses releases nutrients into soil and the environment such as P, nitrogen (N) and carbon (C), of which P has the greatest potential to impact the environment. Although P is not directly toxic, the continued application of P to agricultural land and its subsequent movement to surface waters in runoff can accelerate eutrophication. This can impair water use for industry, recreation, drinking, and fisheries, due to the increased growth of undesirable algae and aquatic weeds. Although N and C are also associated with accelerated eutrophication, most attention has focused on P, due to the difficulty in controlling the exchange of N and C between the atmosphere and a water body, and fixation of atmospheric N by some blue-green algae. Thus, P is often the limiting element and its control is of prime importance in reducing the accelerated eutrophication of surface waters. As many years are required to bring about a significant reduction in soil P levels by crop removal, once eutrophication of a body of water is accelerated, it is usually not cost effective to treat the water body, in addition the internal recycling of sedimentary P can support the growth of aquatic biota even if external inputs are discontinued.

In areas of intensive crop and livestock production, continual P applications as mineral fertilizer and manure have been made at levels exceeding crop uptake (Sharpley, 1995). As a result, surface soil accumulations of P have occurred to such an extent that the loss of P in surface runoff has become a priority management concern if/when transported from the site of application by runoff and erosion. P typically will accumulate in the surface 10 cm of soil, increasing the potential for its transport in runoff, however this is less likely to be an issue for a decomposing carcass that is buried no less three (3) feet from the natural surface of the ground, which is what the rule requires. In the event that the carcass is undergoing natural decomposition, it is possible for P to accumulate in the surface soil, but the rule requires a setback distance of no less than ¼ mile from any “well, lake, pond, stream, surface water intake, public or private drinking water supply, springs or sinkholes”.

Most of Idaho’s drinking water comes from ground water sources. However, approximately 5% of public water systems in Idaho draw from surface water that may be at risk for harmful algal blooms (HABs). Blue-green algae are naturally occurring bacteria that photosynthesize like algae and plants. Under certain conditions, however, the blue-green algae can grow rapidly and produce toxins called cyanotoxins that pose a risk to human health as well as wildlife and domestic animals (Idaho DEQ).

Section 22-101A(3)(b) and (c), Idaho Code. Identification of the expected risk or central estimate of risk for the specific population or receptor and identification of each appropriate upper bound or lower bound estimate of risk.

As mentioned above, the greatest risk to environmental or public health is from phosphorus release from the decomposing carcass that may potentially reach surface or groundwater sources and initiate a series of events that could lead to eutrophication. Eutrophication is defined as an increase in the fertility status of natural waters that can causes accelerated growth of algae or aquatic plants. Undesirable aquatic plant growth results from additions of phosphorus, increases the demands of oxygen by microorganisms and depleted the level of oxygen in the water. Specific health risks may appear when fresh water, extracted from eutrophic areas, is used for the production of drinking water. However, cyanotoxins are not currently regulated for public water systems.. Cyanotoxins have been reported in Idaho's surface waters and in July 2018, one public drinking water system was impacted by a harmful algal bloom; however, cyanotoxin levels in the treated (finished) water were below health advisory levels. Unregulated private drinking water sources that receive drinking water from surface water sources are also at risk from cyanotoxins. In Idaho, approximately 400,000 people are not served by regulated public water systems, but rely on private domestic wells to withdraw ground water for drinking water. The potential or absolute risk of this possibility is not quantified. Harmful algal blooms have been reported in Idaho during the summer months for the past several years. (Idaho DEQ)

Section 22-101A(3)(d), Idaho Code. Identification of each significant uncertainty identified in the process of the assessment of public health effects or environmental effects and any studies that would assist in resolving the uncertainty.

The processes associated with cadaver decomposition in outdoor settings, particularly those that occur during the extended postmortem interval (PMI), beyond 30 days, are poorly understood. Thus, few methods are currently available to accurately estimate the extended postmortem interval (Benninger, 2008). Of these methods, a soils-based approach has the potential to address the postmortem interval between which entomology and anthropology are the most valuable. Although the validity of soil-based methods has previously been established, little work has been conducted to explain the processes that have been designated for forensic application. The dynamics of carbon, nitrogen, and phosphorus-based compounds in soil beneath pig cadavers (gravesoil) that were placed on the soil surface over a period of 100 days and decomposition was assessed through the physical characteristics of the cadaver, soil pH, soil moisture content, and the concentration of total carbon, total nitrogen, soil-extractable phosphorus, and lipid-phosphorus in soil. Cadaver decomposition did not result in a significant difference in soil carbon and moisture content. However, significant increases were observed in the concentration of soil pH, total nitrogen, soil-extractable phosphorus, and lipid-phosphorus. Based on the current results, a significant increase in the concentration of gravesoil nutrients represented a maximum PMI of 43 days (lipid-P), 72 days (total nitrogen), or 100 days (soil-extractable phosphorus). This work provides further evidence that a soil-based method has the potential to act as a tool for the estimation of extended PMI. Data analysis does, however, indicate that the decomposition rate of buried cadavers is highly dependent on the depth of burial and environmental temperatures. The depth at which the cadaver was buried also directly affected the degree of soil and vegetational changes as well as access by carrion insects (Rodriguez, 1985). In order to understand the complex associations between a decomposing carcass and the soil system, additional research must be conducted in both controlled laboratory environments and outdoor field environments.

Section 22-101A(3)(e), Idaho Code. Identification of studies known to the director that support, are directly relevant to, or fail to support any estimate of public health effects or environmental effects and the methodology used to reconcile inconsistencies in the data.

The referenced studies and analyses will be included in the rulemaking record and can be reviewed during the public comment period for further detailed information regarding health effects.

References:

Benninger LA, Carter DO, Forbes SL. 2008. The biochemical alteration of soil beneath a decomposing carcass. Forensic Science International. 180:70-75.

Bhandari, A.B., N.O. Nelson, D.W. Sweeney, C. Baffaut, J.A. Lory, G.M.M.M.A. Senaviratne et al. 2017. Calibration of the APEX model to simulate management practice effects on runoff, sediment, and phosphorus loss. J. Environ. Qual. doi:10.2134/jeq2016.07.0272

Brathen KA, Danell K and Berteaux D. 2002. Effect of muskox carcasses on nitrogen concentration in tundra. Arctic 55:389–394.

Carter DO and Tibbett M. 2006. Microbial decomposition of skeletal muscle tissue (Ovis aries) in a sandy loam soil at different temperatures. Soil Biology and Biochemistry. 38:1139-1145.

Chaubey, I., Migliaccio, K.W. et al. 2006. Phosphorus modeling in soil and water assessment tool (SWAT) model. Modeling Phosphorous in the Environment.

Chesapeake Bay Program. 2013. Bay barometer 2011– 2012. Spotlight on health and restoration in the Chesapeake Bay and its watershed. https://www.chesapeakebay.net/documents/10-Pg_CBP_Barometer_for_web.pdf (September 9, 2019).

Dent BB, Forbes SL and Stuart BH. 2004. Review of human decomposition processes in soil. Environmental Geology 45:576–585.

Idaho Department of Environmental Quality (DEQ). Cyanobacteria Harmful Algal Blooms – Current Health Advisories and Map.

Melis C, Selva N, Teurlings I, Skarpe C, Linnell JDC and Andersen R. 2007. Soil and vegetation nutrient response to bison carcasses in Bialowieza Primeval Forest. Poland Journal of Ecological Research 22:807–813.

Michalak, A.M., E.J. Anderson, D. Beletsky, S. Boland, N.S. Bosch, T.B. Bridgeman et al. 2013. Record-setting algal bloom in Lake Erie caused by agricultural and meteorological trends consistent with expected future conditions. Proc. Natl. Acad. Sci. U. S. A. 110:6448–6452.

Mocrief, J., and Drewitz. 2006. Minnesota Phosphorus Index.

Putman, R. 1978. Flow of Energy and Organic Matter from a Carcase during Decomposition: Decomposition of Small Mammal Carrion in Temperate Systems 2. *Oikos, 31*(1), 58-68.

Rodriguez WC, Bass WM. 1985. Decomposition of buried bodies and methods that may aid in their location. Journal of Forensic Science. 30(3):836-852.

Sharpley A. 1995. Fate and Transport of Nutrients: Phosphorus. USDA Agricultural Research Service.

Stokes K.L., Forbes S.L., Benninger L.A., Carter D.O., Tibbett M. 2009. Decomposition Studies Using Animal Models in Contrasting Environments: Evidence from Temporal Changes in Soil Chemistry and Microbial Activity. In: Ritz K., Dawson L., Miller D. (eds) Criminal and Environmental Soil Forensics. Springer, Dordrecht.

Towne EG. 2000. Prairie vegetation and soil nutrient responses to ungulate carcasses. Oecologica 122:232–239.

Weld, J.L., Parsons, R.L., Beegle, D. B., Sharpley, A.N. et al. 2002. Evaluation of phosphorus-based nutrient management strategies in Pennsylvania. J. Soil Cons. 57: 448-454.