NEPA Analysis for CTUIR at Hanford

Note to EIS preparers. The following information is intended to supplement the Hanford NEPA boilerplate[1] by adding tribal perspectives. This material evolved significantly from the materials submitted by the GTCC Tribal Writers group, but has not been reviewed by them. For questions, please call Stuart Harris (541-966-2400) or Barbara Harper (541-966-2804).

A. CTUIR Introduction to Affected Resources

A.1 History and Standing

For at least 12,000 years, the Columbia River Plateau has supported the survival and thriving for many indigenous peoples. The Columbia River flows through what was a cultural and economic center for the Plateau communities. The indigenous communities were part of the land and its cycles, and it was part of them. The land and its many entities and attributes provided for all their needs: hunting and fishing, food gathering, and endless acres of grass on which to graze their horses, commerce and economy, art, education, health care, and social systems. All of these services flowed among the natural resources, including humans, in continuous interlocking cycles. These relationships form the basis for the unwritten laws or *Tamanwit* that were taught by those who came before, and are passed on through generations by oral tradition in order to protect those yet to arrive. The ancient responsibility to respect and uphold these teachings is directly connected to the culture, the religion, and the landscape along the Columbia Plateau. The cultural identity, survival, and sovereignty of the native nations along the Columbia River and its tributaries are maintained by adhering to, respecting, and obeying these ancient unwritten laws here in this place along the N'Chi Wana, or Big River.

In contemporary times, Indian life along the Columbia River and its tributaries continues to be based on the responsibility to manage modern daily affairs and environmental management practices in a manner consistent with the ancient teachings. This responsibility is to protect, preserve, and enhance this earth including the air, water, and ground, and all that grows and lives here. In order to fulfill this responsibility, the native sovereign nations need cold, clean, uncontaminated water; clean, clear uncontaminated air; uncontaminated soil; clean, vibrant, and uncontaminated biological resources; clean, uncontaminated, and wholesome foods; and clean, uncontaminated, and healthful medicines.

[1] Duncan, J.P. (ed.)(2007) Hanford Site National Environmental Policy Act (NEPA) Characterization. PNNL-6415 Rev. 18.

A.1.1 Treaties of 1855

In 1855, representatives of the U.S. Government signed treaties with representatives from many of the different Indian groups in the southern Plateau. The Indian groups ceded ownership of huge tracts of land to the federal government in return for promises food, education, health care, and other services, and retained the perpetual right to fish, hunt, erect fish-curing structures, gather food, and graze stock throughout the region, including the area in and around Hanford. Through the Treaties, the native nations sought to protect their homeland and food gathering rights within the traditional use areas necessary to sustain their citizens, preserve their cultural, subsistence, and ceremonial practices, and ensure the survival of future generations. The Treaties are legal contracts binding the native sovereign nations and the United States of America, and bring forth Federal fiduciary and trusteeship responsibilities to protect these interests.

A.1.2 Nuclear Waste Policy Act of 1982 and Tri-Party Agreement of 1989

The Nuclear Waste Policy Act of 1982 recognized the three native nations (the Confederated Tribes of the Umatilla Indian Reservation, the Yakama Nation, and the Nez Perce Tribe) as "affected Indian Tribes" at Hanford because they have "federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of congressionally ratified treaties" and could be "substantially and adversely affected by the locating of such a facility." (Title 42, Chapter 108).

In 1989, the cleanup of the Site began with the Hanford Federal Facility and Consent Order, also known as the Tri-Party Agreement, which is the legal framework for cleanup of the Site. Through the original NWPA designation, these three native sovereign nations were recognized as having vital interests in the cleanup process. In 1992, cooperative agreements between the U.S. DOE-Headquarters and the three affected tribes were agreed upon to enable tribal participation in Hanford cleanup issues and decisions, protection of cultural resources, and (more recently) to engage in natural resource injury assessment and restoration activities as Natural Resource Trustees.

A.1.3 Policy on American Indian and Alaskan Native Tribal Government (2000) and DOE Order 1230.2 (1992).

In this policy DOE formalized its commitment to meeting its government-to-government relationships. The most important doctrine derived from this relationship is the trust responsibility of the United States to protect tribal sovereignty and self-determination, tribal lands, assets, resources, and treaty and other federally recognized and reserved rights. These aspects carry through the evaluation of affected resources.

A.1.4 Framework to Provide Guidance for Implementation of US DOE's Policy (2007) and DOE Oder 144.1

This framework enhances DOE's government-to-government working relationship with Indian Nations. DOE offices of EM, NE, SC, and NNSA will work to foster the

government-to-government relationship with Indian Nations impacted by its activities and to maintain DOE'S trust responsibilities including: (a) protecting tribal people and tribal resources from EM, NE, SC, or NNSA actions that could harm their health, safety, or sustainability; and (b) protecting cultural and religious artifacts and sites on lands managed by DOE. DOE will endeavor to protect natural resources which include plants, animals, minerals, and natural features that have religious significance to Indian tribes and/or are held in trust by the Federal Government. The aspects of health and resource protection carry through the evaluation of affected resources.

A,2 The Fiduciary Trust Relationship

"The Federal Government has enacted numerous statutes and promulgated numerous regulations that establish and define a trust relationship with Indian tribes. The United States continues to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, tribal trust resources, and Indian tribal treaty and other rights" (Executive Order 13175, 65 Fed. Reg. 67249 (November 9, 2000)).

The Ninth Circuit has underscored the importance of trust responsibility for all agencies:

> "We have noted, with great frequency, that the federal government is the trustee of the Indian tribes' rights, including fishing rights. *See*, e.g., Joint Bd. of Control v. United States, 862 F.2d 195, 198 (9th Cir. 1988). This trust responsibility extends not just to the Interior Department, but attaches to the federal government as a whole."

Tribal trust law is most well developed in the arena of trust property and money[2]. Indian Trust assets include, but are not limited to money, lands, rights, and water. The federal Indian trust doctrine is considered the "cornerstone" of federal Indian law.

> *See* Dep't of the Interior v. Klamath Water Users Protective Ass'n, 532 U.S. 1, 11 (2001) ("The fiduciary relationship has been described as 'one of the primary cornerstones of Indian law,' and has been compared to one existing under a common law trust, with the United States as trustee, the Indian tribes or individuals as beneficiaries, and the property and natural resources managed by the United States as the trust corpus.").

The courts have made it clear that certain kinds of Indian property and monies are held by the United States in trust. In such cases, the government must assume the obligations of a fiduciary or trustee. The courts have imposed trust duties with respect to tribal funds. Additionally, as the Indian Claims Commission noted, "the fiduciary obligations of the United States toward restricted Indian reservation land, including minerals and timber, are established by law and require no proof." *Blackfeet and Gros Ventre Tribes of*

[2] **http://www.msaj.com/papers/43099.htm**

Indians, 32 Ind. Cl. Comm. 65, 77 (1973). As a general matter, the United States must properly manage and, protect such resources as: tribal land, *United States v. Shoshone Tribe of Indians*, 304 U.S. 111 (1938); *Lane v. Pueblo of Santa Rosa*, 249 U.S. 110 (1919); tribal minerals, *Navajo Tribe of Indians v. United States*, 9 Cl. Ct. 227 (1985); oil and gas, *Navajo Tribe of Indians v. United States*, 610 F.2d 766 (Ct. Cl. 1979); grazing lands, *White Mountain Apache Tribe v. United States*, 8 Cl. Ct. 677 (1985); water, I*d.*, and timber, *United States v. Mitchell*, (*Mitchell II*), *supra*.

> "An Indian Trust Asset (ITA) is defined by the Bureau of Reclamation (Reclamation) as a legal interest in an asset that is held in trust by the U.S. Government for Indian Tribes or individual Tribal members. Examples of ITA's include water rights, lands, minerals, hunting and fishing rights, money, and claims."[3]

Fiduciary trustee must always act in the interests of the beneficiaries (*Covelo Indian Community v. FERC*, 895 F.2d 581 (9th Cir. 1990 at 586). A trustee is obligated to not waste the trust asset. The Trust responsibility means that the federal government needs to be on the side of the Tribes. The federal government must act on behalf of the tribe, and is not supposed to treat tribes as stakeholders to be considered.

The Supreme Court, in defining the trust responsibility, has held that:

> [The federal government] has charged itself with moral obligations of the highest responsibility and trust. Its conduct, as disclosed in the acts of those who represent it in dealing with the Indians, should therefore be judged by the most exacting fiduciary standards. *Seminole Nation v. United States*, 316 U.S. 286, 296-97 (1941).

United States v. White Mountain Apache Tribe, 537 U.S. 465, 475 (2003) recognizes that the fundamental common law duty of a trustee is to maintain trust assets. Fort Mojave Indian Tribe v. United States, 23 Cl. Ct. 417, 426 (Cl. Ct. 1991) found the federal trust duty to protect Indian water rights because "the title to plaintiffs' water rights constitutes the trust property which the government, as trustee, has a duty to preserve."

The same trust principles that govern private fiduciaries also define the scope of the federal government's obligations to the Tribe. *See Covelo Indian Community v. F.E.R.C.*, 895 F.2d 581, 586 (9th cir. 1990). These include: 1) preserving and protecting the trust property; 2) informing the beneficiary about the condition of the trust resource; and 3) acting fairly, justly and honestly in the utmost good faith and with sound judgment and prudence. *See Assiniboine and Sioux Tribes v. Board of Oil and Gas Conservation*, 792 F.2d 782, 794 (9th Cir. 1986); *Trust*, 89 C.J.S. §§ 246-62. Additionally, a long line of cases imposes a trust duty of protection on agencies when their off-reservation actions threaten the use and enjoyment of Indian land. *See, e.g., Northern Cheyenne Tribe v. Hodel*, 851 F.2d 1152 (9th Cir. 1988); *Joint Tribal Council of Passomoquaddy Tribe v. Morton*, 528 F.2d 370, 379 (1st Cir. 1975).

[3] http://www.ose.state.nm.us/water-info/AamodtSettlement/Appendix21.pdf

In addition to the fiduciary trust obligations of the federal government to the Hanford tribes, the Confederated Tribes of the Umatilla Indian Reservation, Yakama Nation, and the Nez Perce Tribe are recognized by the federal government as trustees of the natural resources at Hanford.[4]

> "The concept of natural resource trustees is derived from the public trust doctrine. This ancient principal of law provides that governments hold certain property and natural resources in trust for the benefit of the public. Furthermore, the governments have the duty and authority to protect and preserve such property and resources for public uses."

Both CERCLA and OPA define "natural resources" broadly to include "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources..." Both statutes limit "natural resources" to those resources held in trust for the public, termed Trust Resources. While there are slight variations in their definitions, both CERCLA and OPA state that a "natural resource" is a resource "belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by" the United States, any State, an Indian Tribe, a local government, or a foreign government [CERCLA §101(16); OPA §1001(20)].[5]

In summary, it is the opinion of the CTUIR and the Indian Writer's Group that the "reference location" for the GTCC disposal at Hanford involves a Trust Resource under natural resource trusteeship rules, and has associated obligations of the federal fiduciary trustee (the federal government) to the Tribes, and of the natural resource trustees (Tribes, states, and federal government) to each other and their constituencies.

A.3 Regional and Sitewide Tribal Context

The natural law, or Tamanwit, teaches that American Indian people are not separate from the environment. A tremendous amount of tribal knowledge is contained and taught through oral traditions. Some stories and oral histories contain factual information, while others contain social principles and cultural values. Traditional environmental knowledge reflects tribal science and keen observation, sometimes expressed as accurate explanations of environmental processes, and sometimes expressed in symbolic terms. These teachings have been built over thousands of years, and teach each generation how to live and behave to sustain themselves and the community. This lifestyle is resilient, having persisted through floods, droughts, cataclysms, upheavals, and warfare.

[4] http://www.hanford.gov/?page=292&parent=291
[5] http://www.epa.gov/superfund/programs/nrd/primer.htm

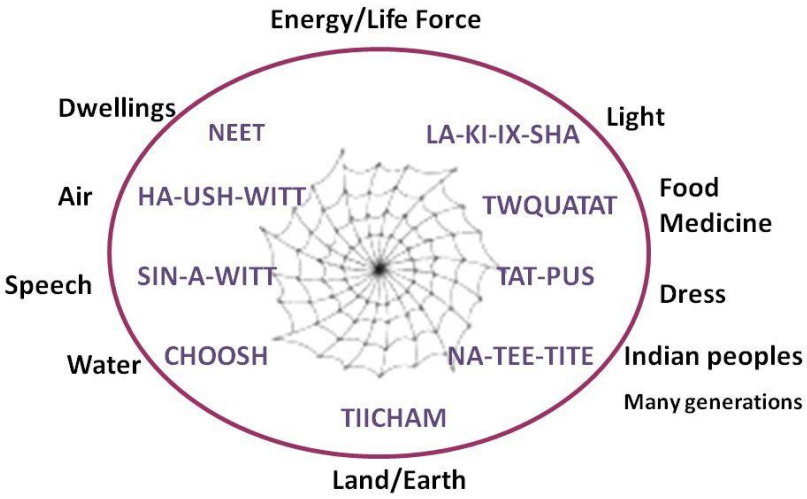


Figure. Depiction of CTUIR Tamanwit, the Natural Law.

Native American ties to the environment are much more complex and intense than is generally understood by risk assessors (Harris 1998). All of the foods and implements gathered and manufactured by the traditional American Indian are interconnected in at least one way, but more often in many ways. Everything is woven together in a web that extends across space-time. To many American Indians, individual and collective well-being is derived from membership in a healthy community that has access to, and utilization of, ancestral lands and traditional resources, so that they may fulfill their part of the natural cycles and their responsibility to uphold the natural law. Adverse impacts to one resource ripple through the entire web and through interconnected biological and human communities. Therefore, if the link between a person and his/her environment is severed through the introduction of contamination or physical or administrative disruption, natural resource service flows may be interrupted, the person's health suffers, and the well being of the entire community is affected.

B. CTUIR Affected Resources – Features, Attributes, Goods, and Services

B.1 Climate and Ethnohistory

People have inhabited the Columbia Basin throughout the entire Younger Dryas era (from 10,000 years ago to the present). Several even earlier archaeological sites are known. Mammoth and bison harvest sites are found throughout the Columbia Plateau. As the temperatures rose throughout this period, the Pleistocene lakes began to shrink and wither away into alkali basins. The post-glacial grasslands of the Great Basin and Columbia Basin were replaced by desert grasses, juniper, and sage, and megafauna likewise decreased through ecological and hunting pressure. The glaciers in the Cascades, Wallowa and Steens mountains rapidly disappeared.[6]

After about 5400 B.P. increasing precipitation and rising water tables were apparent again on both sides of the Cascades. Pollen history indicates continual short, sharp climatic shifts that, directly (e.g., soil moisture) or indirectly (e.g., fire and disease), produced rapid changes in the Northwest's vegetation. The plants and animals were now modern in form. Hunters switched to deer, elk, antelope and small game such as rabbits and birds. Fishing also became important along the coastal streams and in the Columbia River system, with an increasing emphasis on the annual runs of the salmon even though salmon runs date considerably farther back. [6]

The human ethnohistory in the Columbia Basin is divided into cultural periods that parallel the climatic periods and represent cultural adaptations to changing environmental conditions. Throughout this entire period the oral history continually added information needed for survival and resiliency as the climate fluctuated. The oral history of local native people is consistent with contemporary scientific and historic knowledge of the region and validates the extreme climate changes that have occurred in the region over thousands of years. Cameron (2008)[7] examined archaeological, ethnographic, paleo-environmental, and oral historical studies from the Interior Plateau of British Columbia, Canada, from the Late Holocene period, and found correlations among all four sources of information.

Tribal stories tell of eruptions, volcanoes, great floods, and animals now extinct. Indian people on the Columbia Plateau have stories about the world being destroyed by fire and water. Some of these were directly experienced, for example, the Mazama eruption

[6] http://www.oregon-archaeology.com/archaeology/oregon/;
http://www.wac6.org/livesite/precirculated/1803_precirculated.pdf;
Mehringer, P.J. (1996) "Columbia River Basin EcosystemsL Late Quaternary.
http://www.icbemp.gov/science/mehringe.pdf.

[7] Camerion, I (2008) "Late Holocene environmental change on the Interior Plateau of Western Canada as seen through the archaeological and oral historical records." World Archaeological Congress 6, Dublin, Ireland.

6,800 years ago, and the last of the Missoula floods 13,000 years ago. A major landscape feature at Hanford, Gable Mountain or Nookshia (Relander1986: 305), is remembered when it rose out of the flood waters. Older events were accurately inferred from geologic features and then taught, either as literal explanations of the physiography or in symbolic terms as stories or fables (i.e., taking the opportunity to teach a beneficial eco-behavioral lesson).

Large scale manipulation of plants and animals through fire as a tool to reduce plants tied up in climax vegetation and to increase valued plant (and animals that depended on them) started perhaps 3500-3000 years ago, particularly in moister areas where burning out climax vegetation reduced the biomass tied up in cellulose (trees), and increased the diversity of the natural habitat. Important species such as elk, camas (a root food), tarweed (a seed food) and oak were enhanced with periodic burning. Other plants used for food, medicine, and fiber also increase in relative abundance with the use of fire.

Climate change that will occur over the next 10,000 years will inevitably draw on knowledge from the past, whether the climate becomes wetter or drier. Evaluation of future climate scenarios will need to include as much variation as occurred in the last 10,000 years.

B.2 Air Quality

The importance of clean fresh air is often overlooked in NEPA analysis. For example, while wind and fire are part of the natural regime, and an intact soil surface with a cryptogam crust in the desert reduces dust resuspension during wind events.

While chemical and radioactive air emissions are relatively low at Hanford presently, the extensive cleanup and construction activities on Hanford contribute to blowing dust, increased traffic, diesel emissions, deposition or re-deposition of radionuclides, and generation of ozone, particulate matter, and other air pollutants with unknown human and environmental health effects. Viewshed and haze are also affected.

B.3 Physical Resources

It is well known that environmental attributes or qualities such as wilderness, solitude, peace, calm, quiet, and darkness are important to individual species that need large undisturbed habitat as well as to humans who value those experiential qualities[8]. These qualities are very fragile, and once lost are hard to recover. A single light at night breaks the quality of darkness, just as the first drop of contamination changes the quality of water from pure to impure. CTUIR recommends that more attention be paid to the value of unfragmented and undisturbed shrub steppe habitat and natural resources.

[8] http://findarticles.com/p/articles/mi_m1145/is_n8_v29/ai_15769900/; http://findarticles.com/p/articles/mi_m1145/is_n8_v29/ai_15769900/

B.3 .1 Quiet

Noise can affect living organisms in the ecosystem through interruption of reproductive cycles and migration patterns, and driving away species that are sensitive to human presence. Non-natural noise can be offensive while traditional ceremonies are being held. The noise generated by the Hanford facility may presently create noise interference for ceremonies held at sites like Gable Mountain and Rattlesnake Mountain by interrupting the thoughts and focus and thus the spiritual balance and harmony of the community participants of a ceremony (Greider 1993)[9].

B.3.2 Darkness

Light at night affects nocturnal animals such as bats, owls, night crawlers and other species. Night light also has known affects on diurnal creatures and plants by interrupting their natural patterns. Light can affect reproduction, migration, feeding and other aspects of a living organism's survival. Light at night also disrupts the quality of human experience, including star gazing and cultural activities. Extensive light pollution is already being produced from by the Hanford site.

B.4 Geological Resources

Geological resources include soils, sediments, minerals, geological landscapes and associated features, borrow materials, gas, and petroleum.

B.4.1 Soils, Minerals

Native Peoples understand the importance of soils and minerals. Many uses of soils are included in the attached material on exposure pathways. At Hanford, material from the White Bluffs was used for cleaning hides, making paints, and whitewashing villages. Borrow material for caps, barriers, and clean fill is a particular concern, and needs to be part of each NEPA analysis.

B.4.2 Landscapes

The human aspects of Hanford landscapes are discussed briefly here. The CTUIR recommend that DOE pay more attention to landscape features and visual and aesthetic services that flow from the geologic formations at Hanford. Cultural and sacred landscapes may be invisible unless they are disclosed by the peoples to whom they are important. Tribal values lie embedded within the rich cultural landscape and are conveyed to the next generation through oral tradition by the depth of the Indian languages. Numerous landmarks are mnemonics to the events, stories, and cultural practices of native peoples. Oral histories impart basic beliefs, taught moral values and the land ethic, and helped explained the creation of the world, the origin of rituals and

[9] Greider, T (1993) Aircraft Noise and the Practice of Indian Medicine: The Symbolic Transformation of the Environment. Human Organization 52(1): 76-82.

customs, the location of food, and the meaning of natural phenomena. The oral tradition provides accounts and descriptions of the region's flora, fauna, and geology. Within this landscape are songs associated with specific places; when access is denied a song may be lost.

"At Hanford there are three overlapping cultural landscapes that overlie the natural landscape. These are not displacements of a previous landscape by a new landscape, but a coexistence of all three simultaneously even if one landscape is more visible in a particular area. The first represents the American Indians, who have created a rich archeological and ethnographic record spanning more than 10,000 years. This is the only stretch of the Columbia River that is still free-flowing, and one of the few areas in the Mid-Columbia Valley without modern agricultural development. As a result, this is one of the few places where native villages and campsites can still be found. Still today, local American Indian tribes revere the area for its spiritual and cultural importance, as they continue the traditions practiced by their ancestors." The second landscape was created by early settlers, and the third by the Manhattan Project. Today, DOE is removing much of the visible portion of the Manhattan landscape, returning the surface of the site to a more natural state (restoration and conservation) and thus revealing the cultural landscape that remains underneath.[10]

The Hanford Reach and the greater Hanford Site, a geographic center for regional American Indian religious activities, is central to the practice of the Indian religion of the region and many believe the Creator made the first people here. Indian religious leaders such as Smoholla, a prophet of Priest Rapids who brought the Washani religion to the Wanapum and others during the late 19th century, began their teachings here. Prominent landforms such as Rattlesnake Mountain, Gable Mountain, and Gable Butte, as well as various sites along and including the Columbia River, remain sacred. American Indian traditional cultural places within the Hanford Site include, but are not limited to, a wide variety of places and landscapes: archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant gathering areas, holy lands, landmarks, important places in Indian history and culture, places of persistence and resistance, and landscapes of the heart. Because affected tribal members consider these places sacred, many traditional cultural sites remain unidentified.

More generally, cultural landscapes have been defined by the World Heritage Committee as distinct geographical areas or properties uniquely representing the combined work of nature and of man. They identified and adopted three categories of landscape: the purely natural landscape, the human-created landscape, and an associative cultural landscape which may be valued because of the religious, artistic or cultural associations of the natural and/or human elements.

Sacred natural sites are natural places recognized by indigenous and traditional peoples as having spiritual or religious significance. They can be mountains, rivers, lakes, caves, forest groves, coastal waters, and entire islands. The reasons for their sacredness are diverse. They may be perceived as abodes of deities and ancestral spirits; as sources of

[10] http://www.hanford.gov/doe/history/?history=archaeology.

healing water and plants; places of contact with the spiritual, or communication with the 'beyond-human' reality; and sites of revelation and transformation. As a result of access restrictions, many sacred places are now important reservoirs of biological diversity. Sacred natural sites such as forest groves, mountains and rivers, are often visible in the landscape as vegetation-rich ecosystems, contrasting dramatically from adjoining, non-sacred, degraded environments.[11]

B.4.3 Viewsheds

Viewscapes tend to be panoramic and are made special when they contain prominent topography. Viewscapes are tied with songscapes and storyscapes, especially when the vantage point has a panorama composed of multiple locations from either song or story. Viewscapes are critical to the performance of some Indian ceremonies. As told by a Wanapum elder, within the Hanford viewshed (at an undisclosed location) is at least one calendar wheel that guided native residents in their movements and activities. The wheel had spokes which were duplicated at villages. At each village a white stone was placed in the ground and atop this stood a high post. The post would cast a shadow which was read. When it reached a certain angle, like the spoke in the wheel, the people would respond with the proper action. The wheel was a reference point that held time schedules. Gable Mountain is a central area which is also a point of reference for many ceremonies. Many of the reference points that were set on the ground are organized like the stars – they are related in important ways that are described in detailed songs and stories. Interruption of the vista by large facilities or bright lights impairs the cultural services associated with the viewshed.

A viewshed map is included in the Hanford NEPA boilerplate document (Duncan 2007).

B.5 Water

Water sustains all life. As with all resources, there is both a practical and a spiritual aspect to water. Water is sacred to the Indian people, and without it nothing would live. When having a feast, a sip of water is taken either first or after a bite of salmon, then a bit

[11] Oviedo, G. (2002). member of the Task Force of Non-Material Values of Protected Areas of the World Commission on Protected Areas (WCPA), at the Panel on Religion, Spirituality and the Environment of the World Civil Society Forum, Geneva, 17 July 2002.
Stoffle, R.W., Halmo, D.B., Austin, D.E. (1998). Cultural Landscapes and Traditional Cultural Properties: a Southern Paiute View of the Grand Canyon and Colorado River. American Indian Quarterly, Vol. 21: 229-250.
Walker, D.E., 1991. "Protection of American Indian Sacred Geography," in: *Handbook of American Indian Religious Freedom,* Vecsey, C., Ed., Crossroad, New York, NY, pp. 100-115.

of salmon, then small bites of the four legged animals, then bites of roots and berries, and then all the other foods.

The quality of purity is very important for ceremonial use of water. For example, making a sweat lodge and sweating is a process of cleansing and purification. The sweat lodge should be made with clean natural materials and the water used for sweat-bathing should also be uncontaminated. The concept of sacred water or holy water is global, and often connects people, places, and religion; religions that are not land-connected may lose this concept.[12] Additionally, concepts related to the flow of services from groundwater and the valuation of groundwater are receiving increased attention.[13]

Although DOE's threshold for groundwater injury may be regulatory standards based on human or biological health, perhaps the most important criterion for contamination from a tribal perspective is the first drop of contamination, which moves the water from a condition of purity to a condition of degraded. This concept sets a threshold of injury at background or the detection limit.

From the CTUIR's perspective, contamination in the groundwater at the Hanford site is the greatest long-term threat to the Columbia River. There is a tremendous volume of radioactive and chemical contamination in the vadose zone and the groundwater. The mechanics of transport of contaminants through the soil to the ground water is still largely unknown. The actual volumes of contamination within the ground water and the direction of ground water flow are not fully characterized. The uncertainly due to this lack of knowledge and the limited technical ability to remediate the vadose zone and ground water puts the Columbia River and its biota at continual risk. The tremendous importance of groundwater means that the uncertainty about present and future contamination must play a key role in the risk assessment – the severity of the consequences if groundwater and the river become more contaminated is high (risk = probability x severity).

[12] Altman, N. (2002) Sacred Water: the Spiritual Source of Life. Mahwah, NJ: Hidden Spring Publ.;
Marks, W.E. (2001) The Holy Order of Water. Vancouver BC: Steiner Books Inc.;
Burmil, S., Daniel, T.C., and Hetherington, J.D. (1999). Human values and perceptions of water in arid landscapes. *Landscape and Urban Planning*, 44: 99-109;
Mazumdar, S. and Mazumdar, S. (2004). Religion and place attachment: A study of sacred places. Journal of Environmental Psychology, 24: 385-397.

[13] National Research Council (1997) Valuing Ground Water: Economic Concepts and Approaches. Washington D.C.: National Academy Press.

B.6 Biological Resources

B.6.1 Ethno-Habitat

Natural resources are integral to many traditional practices and celebrations throughout the year, many of which honor the traditional foods or First Foods. Based on the importance and many uses of the natural resources, an exposure scenario reflecting the underlying **ethnohabitat or eco-cultural system** was developed for use in dose and risk assessments at Hanford (Harper and Harris 1997; Harris and Harper 2000; CTUIR 2004)[14]. Ethno-habitats can be defined as the set of cultural, religious, nutritional, educational, psychological, and other services provided by intact, functioning ecosystems and landscapes. Although the concept of ethnohabitat or ethnoecology has been used various forms in anthropological disciplines for many years, it had never been used in risk assessment.

A healthy ethno-habitat or eco-cultural system is one that supports its natural plant and animal communities and also sustains the biophysical and spiritual health of its native peoples. Ethno-habitats are places clearly defined and well understood by groups of people within the context of their culture. These are living systems that serve to help sustain modern Native American peoples' way of life, cultural integrity, social cohesion, and socio-economic well-being. The lands, which embody these systems, encompass traditional Native American homelands, places, ecological habitats, resources, ancestral remains, cultural landmarks, and cultural heritage. Larger ethno-habitats can include multiple interconnected watersheds, discrete geographies, seasonal use areas, and access corridors.[15] A depiction of the eco-cultural system for the CTUIR is shown as a seasonal round that includes both terrestrial and aquatic resources.

Figure. Umatilla Seasonal Round

[14] Harris, S.G. and Harper, B.L. "A Native American Exposure Scenario." Risk Analysis, 17(6): 789-795, 1997; S Harris and B Harper. "Using Eco-Cultural Dependency Webs in Risk Assessment and Characterization." Environmental Science and Pollution Research, 7(Special 2): 91-100, 2000; http://www.hhs.oregonstate.edu/ph/tribal-grant-main-page.

[15] Modified from the East-Side EIS of the Interior Columbia Environmental Management Plan (ICBEMP).

B.6.2 Terrestrial Resources of the Plateau Culture Area

An ethnoecological approach to describing terrestrial resources begins with a description of the potential natural vegetation within the Columbia Basin ecozones, and then describes the natural resource usage patterns of the Plateau Culture Area.[16]

All natural resources are significant to tribal culture as part of functioning ecosystems, and many are individually important as useful for food, medicines, materials, or other uses. A comprehensive list of potentially injured biota was compiled for the tribal natural resource trustees, including 13 algae species, 56 fish species, 269 bird species, 52 mammal species, 21 amphibian and reptile species, over 800 aquatic and terrestrial plant species, and dozens of orders, families, and genera of aquatic and terrestrial insects.

The Hanford shrub steppe is a Washington State priority habitat[17] due to its large and largely unfragmented nature, which is now rare. In the 1970s, the National Environmental Research Park (NERP) program created seven NERPs to set aside land for ecosystem preservation and study. The Hanford NERP, managed by the Department of Energy, includes the Fitzner/Eberhardt Arid Lands Ecology Reserve, which is the only remaining sizable remnant (312 square kilometers, 120 square miles) of the Washington shrub-steppe landscape that is still in a relatively pristine condition, the industrial zone of the Hanford Site, which contains nuclear production facilities in various stages of cleanup and closure, and buffer zones on the opposite shore of the Columbia River: the US Department of the Interior's Saddle Mountain Wildlife Reserve and the Washington State wildlife management area.[18] Ecological functions that require this degree of intactness is make Hanford very valuable, and make contiguity, biodiversity, and attributes of a similar scale very important to preserve and enhance.

Based on the Presidential Proclamation that established the Hanford Reach National Monument, the CTUIR policy seeks to ensure that all of Hanford will be restored and protected:[19]

> "The area being designated as the **Hanford Reach** National Monument forms an arc surrounding much of what is known as the central **Hanford** area. While a portion of the central area is needed for Department of Energy missions, much of the area contains the same shrub-steppe habitat and other objects of scientific and historic interest that I am today permanently protecting in the monument. Therefore, I am directing you to manage the central area to protect these important values where practical. I further direct you to consult with the Secretary of the Interior on how best to permanently protect these objects, including the possibility of adding lands to the monument as they are remediated."

[16] http://www.fs.fed.us/land/pubs/ecoregions/ch48.html#342I
[17] http://www.fws.gov/hanfordreach/natural-resources.html
[18] http://www.pnl.gov/nerp/
[19] FR Volume 36--Number 23: 1271-1329; Monday, June 12, 2000

In addition to biological resources and natural resource goods, ecological functions and services that flow to people may be injured by contamination or physical disturbance. For tribal members, human use services that natural resources provide include both direct use of resources (e.g., hunting, fishing, and gathering of edible plants) and nonuse services (e.g., spiritual identity). Because Tribal identity is so strongly defined by their relationship to their natural environment, natural resources provide more services (on average) to Tribal members than to other members of the general public.

An overview of the resources that can serve as conduits of exposure to native peoples is presented in the CTUIR and Yakama Nation exposure scenarios. The CTUIR exposure factors based on natural resources is presented in the "Reference Indian" section.

B.6.3 Aquatic Resources of the Plateau Culture Area

The Columbia River, which cuts through the Hanford site, is the life blood of the region, with rich diverse fisheries delicately balanced on thriving aquatic ecosystems. The Hanford Reach is the last free-flowing segment of the Columbia River and is home of the last remaining naturally spawning fall Chinook. Ancestral CTUIR fisheries sites are located throughout the Hanford Reach. The health of the Hanford Reach is the keystone essential to the survival of Columbia Basin fisheries and CTUIR Treaty rights and resources.

Use of the Hanford site and surrounding areas by tribes was tied primarily to the robust Columbia River fishery. Past social activities of native people include gatherings for such activities like marriages, trading, feasts, harvesting, fishing, and mineral collection. Tribal families and bands lived along the Columbia either year round or seasonally for catching, drying and smoking salmon. The reduction of salmon runs, loss of fishing sites due to dam impoundments and 70 years of DOE institutional controls at Hanford have contributed to the degradation of the supplies necessary for this gifting and barter system of CTUIRculture.

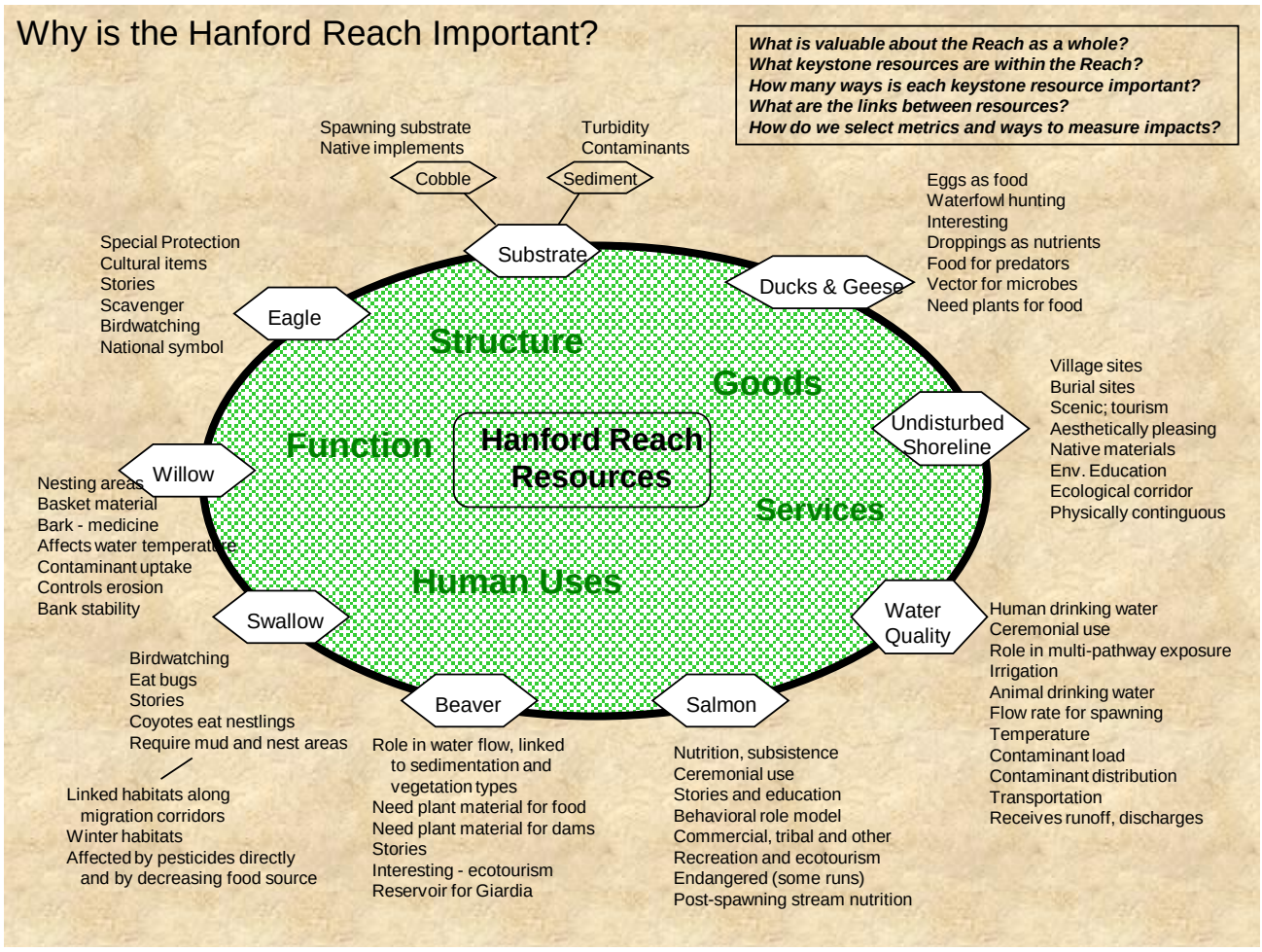
Salmon remains a core part of the oral traditions of the tribes of the Columbia Plateau and it still maintains a presence in native peoples' diet just as it has for thousands of generations. Salmon is among those foods regularly recognized ceremonially. One example is the *ke'uyit* which translates to "first bite." It is a ceremonial feast that is held in spring to recognize the foods that return to take care of the people. It is a long standing tradition among the people and it is immersed in prayer songs and dancing. Salmon is the first food that is eaten by the attendants. Extending gratitude to the foods for sustaining the life of the people is among the tenets of plateau lifestyle. Life is perceived as intertwined with the life of the Salmon. A parallel can be seen between the dwindling numbers of the Salmon runs and the struggle of native people. *from Salmon and His People*[20]

[20] Landeen, D. (1999) Salmon and His People: Fish and Fishing in Nez Perce Culture. Lewiston, ID: Lewis and Clark State College Press.

The people of the Columbia River tribes have always shared a common understanding -- that their very existence depends on the respectful enjoyment of the Columbia River Basin's vast land and water resources. Indeed, their very souls and spirits were and are inextricably tied to the natural world and its myriad inhabitants. Among those inhabitants, none were more important than the teeming millions of anadromous fish enriching the basin's rivers and streams. Despite some differences in language and cultural practices, the people of these tribes shared the foundation of a regional economy based on salmon. The Treaties of 1855 between the Tribes and the federal government explicitly reserved the right to continue fishing forever. Over the next century, settlers encroached on most tribal fishing grounds, blocked access, stole nets, destroyed boats, arrested Indians, over-fished, destroyed habitat, and built dams. In 1974 Judge George Boldt decided in *United States v. Washington* (384 F. Supp. 312) that the "fair and equitable share" of fish for tribes was, in fact, 50 percent of all the harvestable fish destined for the tribes' traditional fishing places. The following year, Judge Belloni applied the 50/50 standard to *U.S. v. Oregon* and the Columbia River. Judge Boldt's decision also affirmed tribal rights to self-regulation when in compliance with specific standards. In 1988, Public Law 10- 581, Title IV Columbia River Treaty Fishing Access Sites, was enacted. The primary purpose of the legislation is to provide an equitable satisfaction of the United States' commitment to provide lands for Indian treaty fishing activities in lieu of those inundated by construction of Bonneville Dam (www.critfc.org).

Salmon will always be important and necessary for physical health and for spiritual well-being. Tribal people continue to fish for ceremonial, subsistence and commercial purposes employing, as they always have, a variety of technologies. Tribal people fish from wooden scaffolds and boats, and use set nets, spears, dip nets and poles and lines. Tribal people still maintain a dietary preference for salmon, and its role in ceremonial life remains preeminent.

Aquatic resources in the Hanford Reach (the area of the river flowing through the Hanford site) include many species, including people. An illustration of resource interconnections and services is shown in figure X.


Why is the Hanford Reach Important?
What is valuable about the Reach as a whole?
What keystone resources are within the Reach?
How many ways is each keystone resource important?
What are the links between resources?
How do we select metrics and ways to measure impacts?
Hanford Reach Resources
Structure
Goods
Services
Human Uses
Function
Substrate
Spawning substrate
Native implements
Turbidity
Contaminants
Cobble
Sediment
Eagle
Special Protection
Cultural items
Stories
Scavenger
Birdwatching
National symbol
Ducks & Geese
Eggs as food
Waterfowl hunting
Interesting
Droppings as nutrients
Food for predators
Vector for microbes
Need plants for food
Undisturbed Shoreline
Village sites
Burial sites
Scenic; tourism
Aesthetically pleasing
Native materials
Env. Education
Ecological corridor
Physically continguous
Willow
Nesting areas
Basket material
Bark - medicine
Affects water temperature
Contaminant uptake
Controls erosion
Bank stability
Water Quality
Human drinking water
Ceremonial use
Role in multi-pathway exposure
Irrigation
Animal drinking water
Flow rate for spawning
Temperature
Contaminant load
Contaminant distribution
Transportation
Receives runoff, discharges
Swallow
Birdwatching
Eat bugs
Stories
Coyotes eat nestlings
Require mud and nest areas
Linked habitats along migration corridors
Winter habitats
Affected by pesticides directly and by decreasing food source
Beaver
Role in water flow, linked to sedimentation and vegetation types
Need plant material for food
Need plant material for dams
Stories
Interesting - ecotourism
Reservoir for Giardia
Salmon
Nutrition, subsistence
Ceremonial use
Stories and education
Behavioral role model
Commercial, tribal and other
Recreation and ecotourism
Endangered (some runs)
Post-spawning stream nutrition

TRANSPORTATION

The Middle Columbia Plateau of the Hanford area is the crossroads of the Columbia Plateau, being located half way between the Great Plains and the Pacific Northwest Coast. In the Hanford area major Columbia River tributaries (the Walla Walla, Snake, and Yakima Rivers) flow into this section of the main stem Columbia River. The slow water at the Wallula Gap was one of the few places where the river could be traversed by horses year round including during the spring melt. The river crossing at Wallula provided access to a vast web of trails that crossed the region.

This travel network was utilized by many tribal groups on the Columbia Plateau for thousands of years of foot travel. Early explorers and surveyors utilized and referenced this extensive trail network. Some of the trails have become major highways and rail lines. Part of the ancient trail system, at one time called the Oregon Trail, now Interstate 84 (I-84) is a primary transportation corridor for nuclear waste enters the State of Oregon at Ontario, Oregon. I-84 and a Union Pacific rail line also cross the Umatilla Indian Reservation, including some steep and hazardous grades that are notorious nationally for fog and freezing fog, freezing rain and snow.

Any waste traveling to Hanford will cross many major rivers that are important salmon bearing watersheds including the Snake River, the Burnt River, the Grande Ronde River (Tributaries of the Snake River), the Umatilla River and Columbia River main stem. All of these river systems have threatened and endangered species issues.

Consequence Evaluation

Recommendations for features and measures are presented in a format similar to the Features-Events-Processes (FEPs) method, but reflecting the tribally-important or eco-cultural attributes of each resource. More detail is contained in the text of various other sections.

Resource or Topic	Features, Attributes, Functions, Goods, Services	Measures of loss or benefit (positive or negative movement; degree of movement)
Sitewide Whole	Support services for traditional lifeways; Intact webs of resources, goods, service flows.	Degree of impact (or enhancement) of traditional lifeways by cultural QALY measure (under development); Loss or recovery of individual traditional activities (hunting, gathering, fishing); Loss or recovery of access to areas or media such as groundwater; Security of protection from development or other loss of acreage, resources, or rights.
Landscape	Intact scape for places, names, songs, calendar, other services. Undisturbed physiographic profile.	Loss or preservation of future land use options. Loss or enhancement of conservation potential; Impact on physiographic profile; Loss or recovery of native scapes.
Light, Noise, other aesthetic attributes.	Quiet needed for ceremonies, experiential quality; Darkness needed for same; Buffer of solitude, isolation, safety from intrusion	Degradation or improvement in quiet during transportation and storage; Degradation or improvement in darkness at night during transport and storage; Duration of impacts (lifecycle of operation); Quality of recovery plan after operation is over.
Viewshed	Uninterrupted viewshed	Degrees in visual field without impact x volume of space with natural features; Significance of direction or features of interruption (line of sight).
Air quality, dust	Clean fresh air for life support and quality of life, without toxics, haze, or dust.	More or fewer emissions during construction, transport, operations, closure. Potential for dust resuspension during each phase. Indirect impacts from energy production, ozone emissions, diesel use. Contribution or benefit to PSD area or attainment status. Greenhouse gas emissions.
Soil,	Clean shallow and deep soil; special materials (White Bluffs);	Mass of contaminated soil x degree of exceedance of human health standards x duration of contamination; Undisturbed soil profile; Intactness of cryptogam crust. Access to special materials.
Minerals, gravel, fill, barrier material		Volume and area of clean fill; Quality of resource mitigation actions;

		Minimization of linked resource impacts.
Sediments	Clean sediment	Present or future exceedance of a standard, including tribal health standard; Function in aquatic ecosystems.
Water	Clean, clear, cold water for drinking, ceremonies	Comparison to tribal standards; Gallon-years above detection limit or background.
Terrestrial Ecosystems	Large-scale ecoregion preservation; Support for tribal lifeways components;	Evaluation of NRDA impacts; Preservation of biodiversity; Reduction in ecological stressors; Loss or benefit in contiguity (fragmentation); Formal process for stressor identification; Identification of valued ecological components.
Terrestrial habitats and species	Provision of goods for food, clothing, shelter, ceremonies, mental health, peace of mind, and so on.	Selection of habitat suitability index; Number of impacted ecological acre-years; Consideration of tribally-important species; Number of impacted cultural acre-years; Time to full recovery.
Aquatic Ecosystems	Large-scale ecoregion preservation; Support for tribal lifeways components;	Proximity of action to river; Evaluation of NRDA impacts; Formal process for stressor identification; Identification of valued ecological components.
Aquatic habitats and species, shorelines	Provision of goods for food, clothing, shelter, ceremonies, mental health, peace of mind, and so on.	Impacted number of river-miles Consideration of tribally-important species; Number of impacted cultural acre-years Time to full recovery
Transportation	Features and events related to safety and vulnerability of adjacent areas.	General transportation risks; Routes through tribal lands; Routes near critical habitats, rivers.
Hazardous substances; safety aspects	Baseline (target) is lack of contamination but current condition is tremendous contamination.	Amount of hazardous material imported, generated, stored, or disposed. Amount of hazardous material already on site, both permitted and contaminated.
Human Health	Target is both lack of excessive exposure and active multi-dimensional health promotion.	Individual and community doses and risks using Tribal scenarios, Multigenerational exposures and risk, Consideration of broader health context.
Env Justice	Tribally-appropriate EJ analysis needed to understand disproportionate impacts.	Compliance with Treaty and Trust; Presence of disadvantaged or disproportionally affected groups-Tribes; Eco-spatial basis for tribal EJ analysis.
Economic	Recognition of subsistence economy methods.	Convention analysis for general pop; Impacts to subsistence for tribes.
Cultural Resources	Need evaluation of likelihood of adverse or beneficial impacts to sites, zones, districts.	Amount of activity in TCP, archaeological zone, sacred sites, and NHPA sites.
Energy and Infrastructure	Need lifecycle energy and infrastructure evaluation, including adequacy of closure plans.	Energy requirement Infrastructure footprint Replacement-mitigation of resources Road needs, water and sewer needs. Intensity of security needs
Climate-Energy Values	Targets of energy efficiency, net zero, sustainability, planning for	Net-zero operations Carbon footprint

	climate change.	
Cumulative	Lifeways support	Impacts to health, ecology, cultural, socio-economic, other analyses. Space-time mapping of impacts. Lifecycle impacts and costs. Sitewide totals of hazardous materials, footprints; Impact on the ability to reach a fully restored endstate.

PLATEAU SUBSISTENCE ECONOMY

The eco-cultural system described in other sections includes human, biological, and physical components, and supports the flow of nutritional, religious, spiritual, educational, sociological, and economic services. No component or service is separable from any other. It is well-recognized in anthropology that indigenous cultures include networks of materials interlinked with networks of obligation and trust. Indian people engage in a complex web of exchanges that are the foundation of community and intertribal relationships. Together these networks determine how materials, services, and information flow within the community and between the environment and the community.

In economic terms, this system is called a subsistence economy. An explanation of "subsistence" developed by the EPA Tribal Science Council is as follows.[21]

> "Subsistence is about relationships between people and their surrounding environment, a way of living. Subsistence involves an intrinsic spiritual connection to the earth, and includes an understanding that the earth's resources will provide everything necessary for human survival. People who subsist from the earth's basic resources remain connected to those resources, living within the circle of life. Subsistence is about living in a way that will ensure the integrity of the earth's resources for the beneficial uses of generations to come.

As the National Park Service explains,

> "While non-native people tend to define subsistence in terms of poverty or the minimum amount of food necessary to support life, native people equate subsistence with their culture. It defines who they are as a people. Among many tribes, maintaining a subsistence lifestyle has become the symbol of their survival in the face of mounting political and economic pressures. To Native Americans who continue to depend on natural resources, subsistence is more than eking out a living. The subsistence lifestyle is a communal activity that is the basis of cultural existence and survival. It unifies communities as cohesive functioning units through collective production and distribution of the harvest. Some groups have formalized patterns of sharing, while others do so in more informal ways. Entire families participate, including elders, who assist with less physically demanding tasks. Parents teach the young to hunt, fish, and farm. Food and goods are also distributed through native cultural institutions. Young hunters, gatherers, and fisherman are required to distribute their first catch or harvest throughout the community at a first feast ceremony. It is a ceremony that illustrates the young person is now a provider for his community. Subsistence embodies cultural values that recognize both the social obligation to share as well as the special spiritual

[21] Tribal Science Council (2002). "Subsistence: A Scientific Collaboration between Tribal Governments and the USEPA." Provided by John Persell (jpersell@lldrm.org).

relationship to the land and resources. This relationship is portrayed in native art and in many ceremonies held throughout the year."[22]

The terms "fish, hunt or gather" are shorthand labels that identify some of the most visible activities within this personally self-sufficient or subsistence economy, but they also include a wide range of associated activities such as preparation, processing, using or consuming, and various traditional and cultural activities. A subsistence economy includes people with a wide range of 'jobs' such as food procurement, processing, and distribution; transportation (pasturing and veterinary); botany/apothecary services; administration and coordination (chiefs); education (elders, linguists); governance (citizenship activities, conclaves); finance (trade, accumulation and discharge of obligations); spiritual health care; social gathering organization; and so on. The categories of 'fish, hunt, and gather' each include a full cross section of these activities. This is why 'hunting' is not just the act of shooting and eating an animal, but includes a full cross-section of all the activities that a hunter-specialist does within their community.

The natural resources that are located on Hanford are essential to this system of relationships. When access and resources needed for personal enterprise associated with salmon or any other resource are blocked, there are psychological, nutritional, monetary, social, welfare, self-esteem, and many other impacts that ripple through the entire community. This includes collection and preparation of animals, plants or other raw materials for foods, ceremonial, medicinal, beadwork, hide work, tule mats and many other items along with the associated trading or gifting. The number of individuals that participate in these personal enterprises would greatly increase if access to Hanford is regained and resources restored.

The more concrete aspects of a subsistence lifestyle are important to understanding the degree of environmental contact and how subsistence is performed in contemporary times. Today, there is an integrated interdependence between formal (cash-based) and informal (barter and subsistence-based) economic sectors that exists and must be considered when thinking of economics and employment of tribal people.[23] Today's subsistence family generates may include members engaged in both monetary and subsistent activities as wage-laborers, part-time workers, professional business people, traditional craft makers, seasonal workers, hunters, fishers, artisans, and so on. Today's subsistence utilizes traditional and modern technologies for harvesting and preserving foods as well as for distributing the produce through communal networks of sharing and bartering. This information is used when describing the lifestyle and developing the dietary and direct exposure factors in the "reference Indian" scenario.

[22] National Park Service: http://www.cr.nps.gov/aad/cg/fa_1999/Subsist.htm
[23] http://arcticcircle.uconn.edu/NatResources/subsistglobal.html

Environmental Justice Analysis

DOE analysis of Environmental Justice is uniformly inadequate to address Native American rights, resources, and concerns. At Hanford, Tribal rights, health, and resources are always more impacted than those of the general population due to the traditional lifeways, close connections to the natural and cultural resources, and natural resource trusteeship. Thus, Hanford EJ analyses generally find that beneficial impacts of new missions, such as new jobs or more taxes, accrue to the local non-native community, yet fail to recognize that the majority of negative impacts accrue to Native Americans, such as higher health risk, continuation of restricted access, lack of natural resource improvement, and so on.

President Clinton signed Executive Order 12898 to address Environmental Justice issues and to commit each federal department and agency to "make achieving Environmental Justice part of its mission." According to the Executive Order, no single community should host disproportionate health and social burdens of society's polluting facilities. Many American Indians and Alaskan Natives are concerned about the interpretation of "environmental justice communities" by the U.S. Federal Government in relation to tribes. By this definition, tribes are included as a minority group. However, the definition as a minority group fails to recognize tribes' sovereign nation-state status, identify the federal trust responsibility to tribes, promote economic and social development, or protect the treaty and statutory rights of American Indians and Alaskan Natives.

The identification of rural EJ populations, particularly Native Americans, is not always obvious if an impacted area is not directly on a reservation. If natural resources appertaining to tribes are present, or if cultural resources or traditional sites within a ceded or usual and accustomed are affected, then an "EJ Community" is present. Further, Native American communities face environmental exposures that are greater than those faced by other EJ communities because of their greater contact with the environment that occurs during traditional practices and resource uses.

Thus, the EJ analysis begins with an identification of resources and who uses them, not with county demographics. The first step in evaluating EJ for Native Americans at Hanford is to answer the following questions:

- Do tribal members live in (now or in the past), visit, or use resources from the impacted zone?
- Is the affected area within a tribal historic area, a traditional cultural property, or a tribally important landscape?
- Is the affected area linked ecologically, culturally, visually, or hydrologically to tribal or other EJ population resources or uses?
- Is a tribe a Natural Resource Trustee of the affected resource or lands?

If the answer to any of these questions is positive (the answers are all 'yes' at Hanford), the EJ analysis may proceed with more detailed evaluation.

- *Resource identification and quantification.* Likelihood that cultural resources are present within an impact zone or that the site or resource has tribal or community significance, including sacred sites, historical/ archaeological sites, burial sites, and sites containing important traditional foods, medicines, or cultural materials or with associated cultural uses or history, or general community importance (values recreational areas, physical features by which the community identifies itself, etc.). The quantity of goods and services, or acreage, is quantified in this step.

- *Damage Potential.* The probability and severity of the damage in terms of physical disturbance, existing stressors, contamination, desecration, or degradation. Predicted peak concentrations, time to impact, and resiliency of the affected system are also estimated. This is a vulnerability index that includes aspects of imminence, severity, and resiliency or reversibility. Are tribal exposure factors higher than for a rural residential population?

- *Consequence Potential.* The consequences of the damage on cultural activities, resources or values. This parameter represents the combination of the first two parameters (the probability of a resource being present and the probability of damage). Consequence might be restricted access or loss of future use options, and associated impacts such as loss of place names or a cultural skill associated with loss of access, or interruption of other goods and services. It may also include how much the Trust is fulfilled or not, and the potential for multiple generations to be inequitably affected. [24]

Economic Analysis. Conventional EJ evaluates impacts to local economy and jobs. When Native American resources are impacted, the economic analysis of the subsistence economy is appropriate (see section on Subsistence Economy).

Equity analysis. Evaluating disproportionate impacts to Native Americans involves the following:

- Are the exposures different when the tribal subsistence scenario is used as compared to the rural residential or other non-native scenario? Whose risks are highest?
- Are the natural resources of tribal interest more impacted than those identified by the general population? How important are those resources or places? How many ways are those resources or places important? How large is the impacted area from a tribal perspective?
- Do disparities in impact accumulate over many generations, and do they accumulate at a higher rate in the EJ communities? Have the next seven or more generations been taken into consideration?

[24] Harper, B. and Harris, S. (2001) An Integrated Framework for Characterizing Cumulative Tribal Risks. Posted at www.iiirm.org.; Harper, B.L. and Harris, S.G., **"Measuring Risks to Tribal Community Health and Culture,"** *Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport, Ninth Volume, ASTM STP 1381,* F. T. Price, K. V. Brix, and N. K. Lane, Eds., American Society for Testing and Materials, West Conshohocken, PA, 1999.

- Is the tribe already vulnerable (at risk) due to existing health disparities, economic disadvantages, higher exposure to other toxics, or existence of several dozen co-risk factors (e.g., poor housing, high unemployment, etc – contact authors for more details)?
- What proportion of tribal members is affected (rather than absolute numbers of people)?
- Is the federal fiduciary Trust obligation being met?
- Is cultural awareness and respect shown equitably to the affected tribes as to the local civic entities?[25]

[25] From: AMERIC&AN INDIAN ALASKAN NATIVE ENVIRONMENTAL JUSTICE ROUNDTABLE Albuquerque, New Mexico August 3-4, 2000; Final Report, January 31, 2001. Edited by the Environmental Biosciences Program, Medical University of South Carolina Press.

Cumulative Tribal Impacts

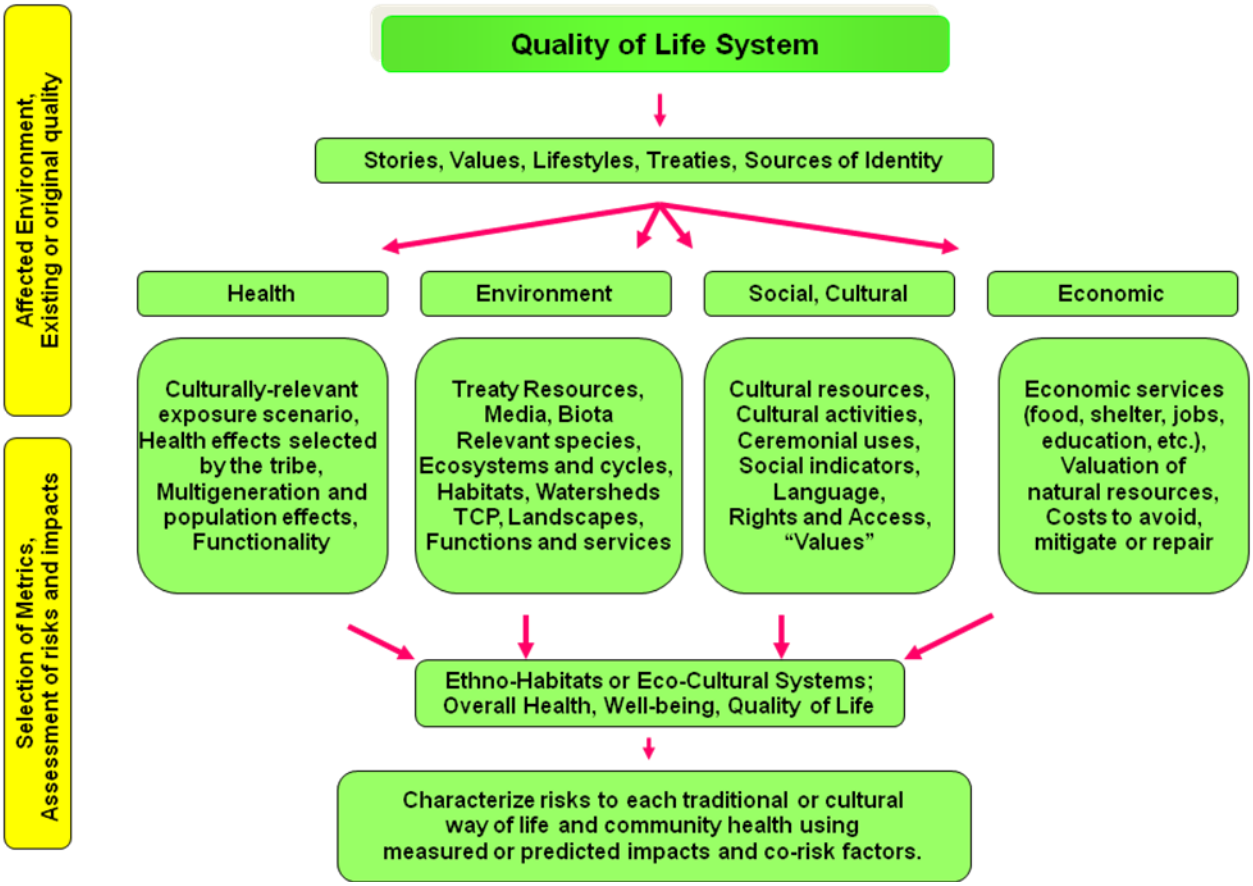
There is a growing recognition that conventional risk assessment methods do not address all of the things that are "at risk" in communities facing the prospect of contaminated waste sites, permitted chemical or radioactive releases, or other environmentally harmful situations. Conventional risk assessments do not provide enough information to "tell the story" or answer the questions that people ask about risks to their community, health, resource base, and way of life. As a result, cumulative risks, as defined by the community, are often not described, and therefore the remedial decisions may not be accepted. The full span of risks and impacts needs to be evaluated within the risk assessment framework in order for cumulative risks to be adequately characterized. This is in contrast to a more typical process of evaluating risks to human health and ecological resources within the risk assessment phase and deferring the evaluation of risks to socio-cultural and socioeconomic resources until the risk management phase (National Research Council, 1994, 1996; President's Commission, 1997).

Because many communities need more information than simply risk and dose results, the Environmental Protection Agency developed a Comparative Risk method over a decade ago for adding a community welfare or quality of life component (EPA, 1993). The Comparative Risk field has been developing methods for community Quality of Life (QOL) that combine cultural, social, and economic measures along with aesthetics and any other factor the community identifies as important. The original Manual (EPA 1993) and many Comparative Risk Projects across the country were developed for situations where environmental planning and prioritization was needed. Several of the Comparative Risk Projects have been done by or for tribes such as the Coeur d'Alene Tribe. The QOL metrics identified in that report included the categories of Localized Effects, Economy/ Subsistence, Aesthetics, Fairness and Equity, Trends (annual and multi-year), Degree of Uncertainty, Personal Well-Being, and Spiritual/Moral factors.

We have modified this concept to reflect traditional tribal cultural values as well as secular or social community aspects that apply to suburban as well as to tribal communities (Harper et al., 1995; Harper and Harris, 2000). We envisioned three or four components to the risk assessment process: human health (using appropriate exposure scenarios), ecological health, and socio-cultural/socio-economic health, all of which are elements of the overall eco-cultural system (Figure).

One of the premises of cumulative impact analysis is that risks to the entire tribal community, not just to a maximally exposed individual, must be evaluated. It is not necessarily true that protecting a MEI protects the entire community, or that protecting threatened and endangered species protects an entire ecosystem. Thus, we need to define tribal community health. John M. Last defines individual human health as "a state characterized by anatomic integrity, ability to perform personal, family, work, and community roles; ability to deal with physical, biological, and social stress; a feeling of well-being; and freedom from the risk of disease and untimely death" (Last 1998). This definition is broader than the regulatory approach which tends to equate good health with lack of excessive exposure. Definitions of health and functionality from the public health

literature include a variety of medical and functional measures, but may not specifically call out the fact that the survival and well-being of every individual and culture depends on a healthy environment.



When risk assessments take a public health approach to defining community and individual health, they integrate human, ecological, and cultural health into an overall definition of community health and well-being. This broader approach used with risk assessments is adaptable to indigenous communities that, unlike westernized communities, turn to the local ecology for food, medicine, education, religion, occupation, income, and all aspects of a good life (Harris, 1998, 2000; Harper and Harris, 2000). The attributes of the eco-cultural system that support these services are described in affected resources as clean fresh air, clean cold water, unimpacted landscapes, clean wholesome foods, clean healthful medicines, and robust thriving habitats and ecosystems.

Human Health-Related Goods and Services: This category includes the provision of water, air, food, and native medicines. In a tribal subsistence situation, the land provided all the food and medicine that was necessary to enjoy long and healthy lives. From a risk perspective, those goods and services can also be exposure pathways.

Environmental Functions and Services: Ecological risk assessment includes narrow examination of exposure pathways to biota as well as examination of impacts to the quality of ecosystems and the services provided by individual biota, ecosystems, and ecology. Broader than this, intact ecosystems provide many functions such as soil stabilization and the human services that result from them. For example, the function of erosion control or dust reduction would provide a human health service related to asthma reduction. Other environmental functions such as nutrient production and plant cover would provide wildlife services such as shelter, nesting areas, and food for people and animals, which in turn might contribute to the health of a species important to ecotourism.

Social and Cultural Goods, Functions, Services, and Uses: This category includes many things valued by suburban and tribal communities about Introduction particular places or resources associated with intact ecosystems and landscapes. Some values are common to all communities, such as the aesthetics of undeveloped area s, intrinsic existence value, environmental education, and so on. Because social impact assessment and other aspects of community health are unfamiliar to risk assessors, several measure are suggested as follows:

- Impact on societal structure and cohesion (hours per year unavailable for social interaction through loss or reduced value of the resource or area)
- Educational opportunity (lost study areas associated with traditional stories or place names or family history or traditional practices; lost R&D opportunity)
- Integrity of cultural resources: number of sites with any disturbance or contamination, weighted by type and years of history associated with the site.
- Access to traditional lands: degree of restricted access (full restriction to any area or resource evidenced by institutional controls or barriers or reduced visits), fraction of ceremonial resources available relative to original quantity and quality
- Cultural landscape quality: proxy scale (1-10?) with elicited judgment based on original condition; total remaining landscape size without encroachments
- Degree of compliance with Treaty rights (proxy scale based on access, safety, natural and cultural resource integrity and quality, freedom from encroachments, hassle-free exercise of rights)
- Degree of Compliance with Trusteeship obligations (basis for NRDA injury, restoration costs, human use of natural resources
- Preservation of future land use and remedial options (acres of permanent losses including plumes, number of uses no longer viable, number of curies x half-life in irretrievable waste forms)
- Degree of sustainability of the resource, its degree of permanent administrative protection, and associated exercise of Treaty rights of access and use.

Economic Goods and Services: This category includes conventional dollar-based items such as jobs, education, health care, housing, and so on. There is also a parallel non-dollar indigenous economy that provides the same types of services, including employment (i.e., the functional role of individuals in maintaining the functional community and ensuring its survival), shelter (house sites, construction materials), education (intergenerational knowledge required to ensure sustainable survival throughout time and maintain personal and community identity), commerce (barter items and stability of extended trade networks), hospitality, energy (fuel), transportation (land and water travel, waystops, navigational guides), recreation (scenic visitation areas), and economic support for specialized roles such as religious leaders and teachers.

Cumulative Space-Time evaluation often leads to impacts expressed as service-acre-years. This is the most common unit of quantification for habitat-scale natural resource injury. In our experience, it is most logical to use cultural service-acre-years as the ecological dimension of tribal impacts. The environmental perspective held by indigenous communities mean that eco-spatial characteristics should be identified and evaluated for the extent, magnitude and duration of eco-cultural impairment of each service. In a cultural evaluation, specific cultural services associated with a site or resource can be identified by tribal elders or other community leaders according to general importance (thus avoiding trespass on intellectual property and proprietary information). As a simple surrogate for many of these services, the areal extent and duration of contamination (i.e., outer boundary at the detection limit) can be measured and graded accorded to the size of the area degraded or the percent of degradation, and the duration for which each gradation of impact persists can be estimated.

The functions and services provided by an intact and functioning habitat have been receiving increased attention recently (Costanza and Folke 1997, Scott et al. 1998, Daly 1996, Daily 1997). Many of the metrics used in natural resource valuation require spatial and temporal descriptors in addition to concentrations at individual points of compliance because they deal with ecosystems. Many of the concerns raised as cultural risk issues are parallel and also related to areas, ecosystems, or landscapes as well as to the duration of the contamination or the effect. Many of the concepts used in natural resource valuation are applicable to the evaluation of cultural risk and the culturally-related goods and cultural services provided by a healthy environment.

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Human Health Risk Assessment -- Reference Indian

Title: A "Reference Indian" for use in radiological and chemical risk assessment.

Authors: B. Harper and S. Harris (CTUIR)

Two tribal exposure scenarios have been developed for use at Hanford by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR 2004) and the Yakama Nation (Ridolfi 2007) in Hanford risk assessments.[26] Both of these scenarios reflect traditional tribal uses of the lands and resources on the Hanford Site, including hunting, fishing, gathering, and use of the sweat lodge. They are multimedia (air, dust, surface soil, vadose soil, surface water, groundwater, plants, and animals) and are full-time residential scenarios. These scenarios should be used to evaluate risks to tribal members at the location of the proposed federal and any impacted areas, i.e., 'Reference Indian' scenarios. These scenarios can also be considered baseline and inadvertent intruder scenarios, as required by DOE Order 435.1.

EPA is required to identify populations who are more highly exposed; for example, subsistence populations and subsistence consumption of natural resources (Executive Order 12898[27]). EPA is also required to protect sensitive populations.[28] Some of the factors known to increase sensitivity include developmental stage, age (very young and very old), gender, genetics, and health status[29], and this is part of EPA's human health research strategy.[30]

> "The Superfund law requires cleanup of the site to levels which are protective of human health and the environment, which will serve to minimize any disproportionately high and adverse environmental burdens impacting the EJ community"[31].

This scenario reflects an active, outdoor lifestyle with a subsistence economic base. Subsistence food sources include gathering, gardening, hunting, pasturing livestock, and fishing. The forager relies all or in part on native foods and medicines, while the residential farmer relies on domesticated but self-produced foods. Thus, the CTUIR scenario is at the foraging end of the subsistence spectrum, while the residential farmer is at the domesticated end of the subsistence spectrum. Both are active, outdoor lifestyles,

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[26] CTUIR (2004) Exposure Scenario for CTUIR Traditional Subsistence Lifeways. Report prepared by the CTUIR Department of Science & Engineering, October. http://www.hhs.oregonstate.edu/ph/tribal-grant/index.html.
Ridolfi Inc. (2007) Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, Richland, Washington. Prepared for the Yakama National ERWM Program. September.

[27] White House, 1994. Federal Actions To Address Environmental Justice In Minority Populations And Low income Populations: Feb. 11, 1994; 59 FR 7629, Feb. 16, 1994.
[28] *Superfund Exposure Assessment Manual*. EPA/540/1-88/001 OSWER directive 9285.5-1. U.S. Environmental Protection Agency Office of Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. 1988.
[29] http://www.epa.gov/nheerl/research/childrens_health.html
[30] EPA/600/R-02/050, September 2003 (posted at http://www.epa.gov/nheerl/publications/).
[31] http://www.epa.gov/region02/community/ej/superfund.htm

and are consistent with the reasonable maximum exposure (RME) approach to baseline risk assessment. Traditional or subsistence scenarios are similar in format to existing residential recreational, or occupational exposure scenarios, but reflect and are inclusive of tribal cultural and lifestyle activities. They are comprised of:

1. standard exposure pathways and exposure factors (such as inhalation or soil ingestion but with increased environmental contact rates),
2. traditional diets composed of native plants and animals possibly supplemented with a home garden, and
3. unique pathways such as the sweatlodge.

Tribal exposure scenarios pose a unique problem in that much of the specific cultural information about the uses of plants and animals for food, medicine, ceremonial, and religious purposes is proprietary. However, major activities in the generally-recognized activity categories can be described in enough detail to understand the basic frequency, duration, and intensity of environmental contact within each category and habitat.

Table 1. Major Activity Categories

Activity Type	***General Description***
Hunting	Hunting includes a variety of preparation activities of low to moderate intensity. Hunting occurs in terrain ranging from flat and open to very steep and rugged. It may also include setting traplines, waiting in blinds, digging, climbing, etc. After the capture or kill, field dressing, packing or hauling, and other very strenuous activities occur, depending on the species. Subsequent activities include cutting, storing (e.g., smoking or drying), etc.
Fishing	Fishing includes building weirs and platforms, hauling in lines and nets, gaffing or gigging, wading (for shellfish), followed by cleaning the fish and carrying them to the place of use. Activities associated with smoking and constructing drying racks may be involved.
Gathering	A variety of activities is involved in gathering, such as hiking, bending, stooping, wading (marsh and water plants), digging, and carrying.
Sweatlodge Use	Sweatlodge building and repairing is intermittent, but collecting firewood is a constant activity.
Materials and Food Use	Many activities of varying intensity are involved in preparing materials for use or food storage. Some are quite vigorous such as pounding or grinding seeds and nuts into flour, preparing meat, and tanning hides, Many others are semi-active, such as basket making, flintknapping, construction of storage containers, cleaning village sites, sanitation activities, home repairs, and so on.

Once the activities comprising a particular subsistence lifestyle are known, they are translated into a format that is used for risk assessment. This translation captures the degree of environmental contact that occurs through activities and diet, expressed as numerical "exposure factors." Direct exposure pathways include exposure to abiotic media (air, water, and soil), which can result in inhalation, soil ingestion, water ingestion, and dermal exposure. Indirect pathways refer to contaminants that are incorporated into biota and subsequently expose people who ingest or use them. There are also unique exposure pathways that are not accounted for in scenarios for the general public, but may be significant to people with certain traditional specialties such as pottery or basket making, flint knapping, or using natural medicines, smoke, smudges, paints and dyes.

These activities may result in increased dust inhalation, soil ingestion, soil loading onto the skin for dermal exposure, or exposure via wounds, to give a few examples. While the portals of entry into the body are the same (primarily via the lungs, skin, mouth), the amount of contaminants may be increased, and the relative importance of some activities (e.g., basketmaking, wetlands gathering), pathways (e.g., steam immersion or medicinal infusions) or portals of entry (e.g., dermal wounding) may be different than for the general population.

Together, this information is then used to calculate the direct and indirect exposure factors. This process follows the general sequence:

1. Environmental setting – identify what resources are available;
2. Lifestyle description – activities and their frequency, duration and intensity, and uses of natural resources;
3. Diet (indirect exposure factors);
4. Pathways and media;
5. Exposure factors - Crosswalk between pathways and direct exposure factors; cumulative soil, water and air exposures.

The basic components of the exposure scenario are given below. A great deal of peer-reviewed documentation has been provided to DOE, and the CTUIR and YN scenarios are being used at Hanford.

- Soil ingestion = 400 mg/d for all age groups
- Inhalation rate = 25 m^3/d for adults, with children scaled from the adult value
- Drinking water = 3L/d for adults, with children scaled from the adult value; an additional 1L is ingested during each use of the sweat lodge.
- Based on the ecological resources and on the anthropological literature, the CTUIR developed two relevant diets, one for the Columbia River regions where salmon forms a large percentage of the protein source, and one for upland and mountain areas with resident fish and spawning areas for anadromous species.

CTUIR Columbia River Diet					CTUIR Blue Mountain Diet				
Food Category	***gpd***	**kcal/ 100g**	**kcal/d**	**Percent of calories**	***Food Category***	***gpd***	**kcal/100g**	**kcal/d**	**Percent of calories**
Fish	620	175	1085	49%	Fish	142	175	249	11%
Game, large and small	125	175	219	10%	Game, large and small	600	175	1050	48%
Fowl & Eggs	62	200	124	6%	Fowl & Eggs	62	200	124	6%
Bulbs (onions, other)	40	30	12	1%	Bulbs (onions, other)	40	30	12	1%
Berries, Fruits	125	100	125	6%	Berries, Fruits	125	100	125	6%
Other vegetation (lichen, pith, cambium)	40	100	40	2%	Other vegetation (lichen, pith, cambium)	40	100	40	2%
Greens, Tea, Medicines, Spices	133	30	40	2%	Greens, Tea, Medicines, Spices	133	30	40	2%
Honey, Sweete	15	275	41	2%	Honey, Sweete	15	275	41	2%
Seeds, Nuts, Grain	24	500	120	5%	Seeds, Nuts, Grain	24	500	120	5%
Roots, Tubers	400	100	400	18%	Roots, Tubers	400	100	400	18%
TOTALS	***1584***		***2206***		***TOTALS***	***1584***		***2201***	

Human Health Reference Indian ADDENDUM – SOIL INGESTION

Ingestion of soil, sediment, or dust is the result of hand-to-mouth contact, swallowing inhaled dust, mouthing of objects, and ingestion of dirt or dust on food. The recommended subsistence soil ingestion rate of 400 mg/d is based on a review of EPA guidance, soil ingestion studies in suburban and indigenous populations, military, construction and utility worker studies, and local climatic, habitat, and geologic conditions. Components of the traditional lifestyle that contribute to soil ingestion include hunting, gathering, digging roots, processing and eating wild foods, preparing and using natural materials such as basket materials, tending livestock, building and repairing sweat lodges, tending cemeteries, and social gatherings. It also considers occupational activities such as wildlife field work, construction or road work, sample collection, and cultural resource field work.

1.0 EPA Guidance

EPA reviewed studies relevant to suburban populations and published summaries in its Exposure Factors Handbook (1989, 1991, and 1997). In the current iteration of the Exposure Factors Handbook[32], EPA recommends100 mg/d as a mean value for children in suburban settings, 200 mg/day as a conservative estimate of the mean, and a value of 400 mg/day as an "upper bound" value (exact percentile not specified). Most state and federal guidance uses 200 mg/d for children and 100 mg/d for adults in residential or agricultural settings.

A value for an ingestion rate for adult outdoor activities is no longer given in the 1997 Exposure Factors Handbook for adults as "too speculative." However, EPA's soil screening guidance recommends 330 mg/d for a construction or other outdoor worker. Risk assessments for construction workers typically use a rate of 480 mg/d. Some states recommend the use of 1 gram per acute soil ingestion event[33] to approximate a non-average day for children, such as an outdoor day.

2.0 Military Guidance

The US military assumes 480 mg per exposure event[34] or per field day (Technical Guide 230).[35] Department Of Defense (2002)[36] recommendations for certain activities such as construction, landscaping, or other field activities is 480 mg/day. During deployment, DOD assumes that half

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[32] Environmental Protection Agency. 1997. Exposure Factors Handbook. Volumes I, II, III. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/P-95/002Fa.

[33] MADEP (1992). Background Documentation For The Development Of An "Available Cyanide" Benchmark Concentration. http://www.mass.gov/dep/ors/files/cn_soil.htm

[34] http://www.gulflink.osd.mil/pesto/pest_s22.htm, citing US Environmental Protection Agency, Office of Research and Development, Exposure Factors Handbook, Volume I, EPA/600/P-95/002a, August 1997 as the basis for the 480 mg/d.

[35] USACPPM TG 230A (1999). Short-Term Chemical Exposure Guidelines for Deployed Military Personnel. U.S. Army Center for Health Promotion and Preventive Medicine. Website: http://www.grid.unep.ch/btf/missions/september/dufinal.pdf

[36] Reference Document (RD) 230, "Exposure Guidelines for Deployed Military" A Companion Document to USACHPPM Technical Guide (TG) 230, "Chemical Exposure Guidelines for Deployed Military Personnel", January 2002. Website: http://chppm-www.apgea.army.mil/desp/; and http://books.nap.edu/books/0309092213/html/83.html#pagetop.

of a soldier's time is spent in thes higher-contact activities. The UN Balkans Task Force assumes that 1 gram of soil can be ingested per military field day[37].

3.0 Studies in suburban or urban populations

Written knowledge that humans often ingest soil dates back to the classical Greek era. Soil ingestion has been widely studied from a perspective of exposure to soil parasite eggs and other infections. More recently, soil ingestion was recognized to be a potentially significant pathway of exposure to contaminants. Several early studies estimated intakes by children. Estimates based on observation of 'sticky sweets' (Day et al., 1975), outdoor activities (Hawley, 1985), or camping (Van Wijnen et al., 1990). Other studies used tracer elements (Binder, et al., 1986; Clausing et al., 1987; Thompson and Burmaster, 1991; Calabrese et al., 1989; Stanek and Calabrese (1995a, 1997). These studies estimated a wide range of soil ingestion rates.

Pica (ingestion of more than 5000 mg/d) is generally thought of as a pediatric condition. ATSDR estimates that between 10 and 50% of children may exhibit pica behavior at some point. Regulatory guidance recommends using a soil ingestion rate of 5 or 10g/d for pica children. Some examples are:

(1) EPA (1997) recommends a value of 10g/d for a pica child.
(2) Florida recommends 10g per event for acute toxicity evaluation[38].
(3) ATSDR uses 5 g/day for a pica child[39].

4.0 Studies in Indigenous Populations

Studies of soil ingestion in indigenous populations have largely centered on estimates of past exposure (or dose reconstruction) of populations affected by atomic bomb tests. Haywood and Smith (1992) estimated potential doses to aboriginal inhabitants of the Maralinga and Emu areas of South Australia by considering the number of hours per week spent in sleeping, sitting, hunting or driving, cooking or butchering, and other activities. They noted that virtually all food, whether of local origin or purchased, has some dust content by the time of consumption due to methods of preparation and the nature of the environment. They recommend a soil intake of 1 to 10 gpd. Other authors have used estimates of 0.5 or 1 gpd in other indigenous populations such as the Marshall Islanders (Sun and Meinhold, 1997; LaGoy, 1987). Simon (1998) recommended using a soil ingestion rate for indigenous people in hunters/food gathering/nomadic societies of 1g/d in wet climates and 2 g/d in dry climates, and 3 g/d for all indigenous children, and 5 g/d if geophagia is common.

These estimates are supported by studies of human coprolites from archaeological sites. For instance, Nelson (1999) noted that human coprolites from a desert spring-fed aquatic system included obsidian chips (possibly from sharpening points with the teeth), grit (pumice and quartzite grains from grinding seeds and roots), and sand (from mussel and roots consumption). Her conclusions are based on finding grit in the same coprolites as seeds, and sand in the same

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[37] UNEP/UNCHS Balkans Task Force (BTF) (1999). The potential effects on human health and the environment arising from possible use of depleted uranium during the 1999 Kosovo conflict. www.grid.**un**ep.ch/btf/missions/september/dufinal.pdf

[38] Proposed Modifications To Identified Acute Toxicity-Based Soil Cleanup Target Level, December 1999, www.dep.state.fl.us/waste/quick_topics/ publications/wc/csf/focus/csf.pdf .

[39] For Example: El Paso Metals Survey, Appendix B, www.atsdr.cdc.gov/HAC/PHA/**elpaso**/epc_toc.html.

coprolites as mussels and roots. She concludes that "the presence of sand in coprolites containing aquatic root fibers suggests that the roots were not well-cleaned prior to consumption.

5.0 Geophagia

Despite the limited awareness of geophagia in western countries, the deliberate consumption of dirt, usually clay, has been recorded in every region of the world both as idiosyncratic behavior of isolated individuals and as culturally prescribed behavior (Abrahams, 1997; Callahan, 2003; Johns and Duquette, 1991; Reid, 1992). It also routinely occurs in primates (Krishnamani and Mahaney (2000). Indigenous peoples have routinely used montmorillonite clays in food preparation to remove toxins (e.g., in acorn breads), as condiments or spices, or to aid digestion (e.g., kaolin clay in Kaopectate) (Reid, 1992; Krishnamani and Mahaney, 2000). Callahan (2003) also suggests that certain soils may reduce parasite loads (demonstrated in monkeys) through immune enhancement, and clays with aluminum salts may have an adjuvant effect as they do in commercial vaccines.

Pregnancy is the most common occasion for eating dirt in many societies, especially kaolin and montmorillonite clays in amounts of 30g to 50g a day. In some cultures, well-established trade routes and clay traders make rural clays available for geophagy even in urban settings. Clays from termite mounds are especially popular among traded clays, perhaps because they are rich in calcium (Callahan, 2003; Johns and Duquette, 1991). In countries such as Uganda where modern pharmaceuticals are either unobtainable or prohibitively expensive, ingested soils may be very important as a mineral supplement, particularly iron and calcium (Abrahams, 1997; Krishnamani and Mahaney, 2000; Johns and Duquette, 1991).

7.0 Data from dermal adherence

Dermal adherence of soil is generally studied in relation to dermal absorption of contaminants, but soil on the hands and face can be ingested, as well. Kissel, et al. (1996) included reed gatherers in tide flats. "Kids in mud" at a lakeshore had by far the highest skin loadings. Reed gatherers were next highest, followed by farmers and rugby players and irrigation installers. Holmes et al. (1999) studied a variety of occupations. Farmers, reed gatherers and kids in mud had the highest overall skin loadings, followed by equipment operators, gardeners, construction, and utility workers. Archaeologists and several other occupations had somewhat lower skin loadings.

Grain size affects adherence and tactile responses to ingested soil. Particles below the sand-silt size division (0.075 mm) adhering more than smaller sizes (see EPA, 1992[40] for more details). Sieving is recommended, and data for particle size <0.044 cm (RAGSe, App. C, Table C-4).

8.0 Data from washed or unwashed vegetables.

Direct soil ingestion also occurs via food, for example from dust blowing onto food (Hinton, 1992), residual soil on garden produce or gathered native plants, particles on cooking utensils, and so on. Beresford and Howard (1991) found that soil adhesion to vegetation was highly

[40] EPA (1992). Interim Report: Dermal Exposure Assessment: Principles And Applications. Office of Health and Environmental Assessment, Exposure Assessment Group. /600/8-91/011B

seasonal, being highest in autumn and winter, and is important source of deposited radionuclides to grazing animals.

9.0 Subsistence lifestyles and rationale for soil ingestion rate

The derivation of the soil ingestion rate is based on the following points:

- The foraging-subsistence lifestyle is lived in close contact with the environment.
- Plateau winds and dust storms are fairly frequent. Incorporated into overall rate, rather than trying to segregate ingestion rates according to number of high-wind days per year because low-wind days are also spent in foraging activities.
- The original Plateau lifestyle – pit houses, caches, gathering tules and roots - includes processing and using foods, medicines, and materials. This is considered but not as today's living conditions.
- The house is assumed to have little landscaping other than the natural conditions or xeriscaping, some naturally bare soil, a gravel driveway, no air conditioning (more open windows), and a wood burning stove in the winter for heat.
- All persons participate in day-long outdoor group cultural activities at least once a month, such as pow-wows, horse races, and seasonal ceremonial as well as private family cultural activities. These activities tend to be large gatherings with a greater rate of dust resuspension and particulate inhalation. These are considered to be 1-gram events or greater.
- 400 mg/d is based on the following:
    1. 400 mg/d is the upper bound for suburban children (EPA); traditional or subsistence activities are not suburban in environs or activities
    2. This rate is within the range of outdoor activity rates for adults (between 330 and 480); subsistence activities are more like the construction, utility worker or military soil contact levels. However, it is lower than 480 to allow for some low-contact days.
    3. The low soil-contact days are balanced with many 1-gram days and events (as suggested by Boyd et al., 1999) such as root gathering days, tule and wapato gathering days, pow wows, rodeos, horse training and riding days, sweat lodge building or repair days, grave digging, and similar activities. There are also likely to be many high or intermediate-contact days, depending on the occupation (e.g., wildlife field work, construction or road work, cultural resource field work).
    4. This rate does not account for pica or geophagy
    5. Primary data is supported by dermal adherence data in gatherers and 'kids in mud'. Tule and wapato gathering are kid-in-mud activities
    6. This rate includes a consideration of residual soil on roots (a major food category) through observation and anecdote, but there is no quantitative data.

Human Health Reference Indian ADDENDUM - INHALATION RATE

Many risk assessments use the EPA default value of 20m^3/d (EPA 1997), which reflects contemporary lifestyles of the general population. However, EPA recognizes that inhalation rates may be higher in certain populations, such as athletes or outdoor workers, because levels of activity outdoors may be higher over long time periods. "If site-specific data are available to show that subsistence farmers and fishers have higher respiration rates due to rigorous physical

activities than other receptors, that data may be appropriate."[41] Such subpopulation groups are considered 'high risk' subgroups.[42]

In order to develop inhalation rates more appropriate to traditional lifestyles, we evaluated the approach that uses specific activity levels to estimate short-term and long-term inhalation rates. Several examples of this approach are:

- EPA's National Air Toxics Assessment (homepage: http://www.epa.gov/ttn/atw/nata/natsa3.html) uses the CHAD database to estimate national average air toxics exposures by selecting a series of single day's patterns to represent an individual's annual activity pattern.
- The California Air Resources Board (CARB, 2000) reviewed ventilation rates for many activities in the CHAD database and concluded that 20 m^3/d represents an 85th percentile of typical adult activity lifestyles reflecting 8 hours sleeping and 16 hours of light activity with little moderate or heavy activity.
- In their technical guidance document, "Long-term Chemical Exposure Guidelines for Deployed Military Personnel," the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommended an inhalation rate of 29.2 m^3/d for US Armed Service members that includes 8 hours of moderate duties.[43]
- EPA used 30 m^3/day for a year-long exposure estimate for the general public at the Hanford Superfund site in Washington state, based on a person doing 4 hours of heavy work, 8 hours of light activity, and 12 hours resting.[44]
- The DOE's Lawrence Berkeley Laboratory also used 30 m^3/d: "the working breathing rate is for 8 hours of work and, when combined with 8 hours of breathing at the active rate and 8 hours at the resting rate, gives a daily equivalent intake of 30 m^3 for an adult."[45]
- The Rocky Flats Oversight Panel recommended using 30 m^3/d.[46]

Using EPA guidance on hourly inhalation rates for different activity levels, a reasonable inhalation rate for an average tribal member's active lifestyle is an average rate of 26.2 m^3/d, based on 8 hours sleeping at 0.4 m^3/hr, 2 hours sedentary at 0.5 m^3/hr, 6 hours light activity at 1 m^3/hr, 6 hours moderate activity at 1.6 m^3/hr, and 2 hours heavy activity at 3.2 m^3/hr. Unlike most other exposure factors, which are upper bounds, the inhalation rate is an average rate, so to be consistent with national methodology, we have rounded the rate down to 25 m^3/day.

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[41] EPA (OSWER) "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Support Materials Volume 1: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" page 6-4, at (http://www.epa.gov/earth1r6/6pd/rcra_c/protocol/volume_1/chpt6-hh.pdf)

[42] Exposure Factors Handbook, 1997, Volume 1. page 5-24

[43] http://www.gulflink.osd.mil/particulate_final/ particulate_final_s06.htm and http://www.gulflink.osd.mil/pm/pm_en.htm.

[44] "Report of Radiochemical Analyses for Air Filters from Hanford Area" Memorandum from Edwin L. Sensintaffar, Director of the National Air and Radiation Environmental Laboratory to Jerrold Leitch, Region 10 Radiation Profram Manager (http://yosemite.epa.gov/R10/AIRPAGE.NSF/webpage/Hanford+Environmental+Perspective)

[45] (www.lbl.gov/ehs/epg/tritium/TritAppB.html)

[46] RAC (Risk Assessment Corporation). 1999. *Task 1: Cleanup Levels at Other Sites. Rocky Flats Citizens Advisory Board, Rocky Flats Soil Action Level Oversight Panel.* RAC Report No. 3-RFCAB-RFSAL-1999' http://www.itrcweb.org/Documents/RAD-2.pdf

The estimate of the activity levels associated with traditional lifestyles is based on anthropological studies, ethnographic literature on foraging theory and hunting-gathering lifestyles, and confirmatory interviews with Tribal members. The inhalation rate reflects a wide range of traditional indoor and outdoor activities, including (a) youth who are learning traditional subsistence skills, (b) adults who hunt, gather, fish, and work in environmental management occupations, and (c) elders who gather plants and medicines, prepare and use them, and teach traditional activities. At present, it is not possible to extrapolate directly from the CHAD database from window washing, for example, to hide scraping; research is underway to fill this data gap using heart rate monitors keyed to respiration rate during specific traditional activities.

Finally, there may be some ethnic specificity in the link between metabolic and inhalation rates such as thrifty genotype(s) and oxidation adiposity patterns (Goran, 2000; Fox et al., 1998; Muzzin et al., 1999; Rush et al., 1997; Saad et al., 1991; Kue Young et al., 2002), as well as ethnic differences in spirometry (Crapo et al., 1988; Lanese et al., 1978; Mapel et al., 1997; Aidaraliyev et al., 1993; Berman et al., 1994). There are several stress response genes that enable indigenous populations to respond to environmental stresses and to the rapid transition between extremes, including feast and famine, heat and cold, disruption in circadian rhythms, dehydration, seasonality, and explosive energy output or rapid transitions between minimum and maximum exercise and $VO2_{max}$ (Kimm et al., 2002; Snitker et al., 1998). This may affect inhalation rate, but at present this remains a testable hypothesis.

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