The Colors of Illegal Dumping

A Field Guide for Visual Assessment

of Illegally Dumped Bulk Waste Materials in Southeast New Mexico

A 2023 PARTNERSHIP PROJECT

Updated and Revised 10/01/23

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The Colors of Illegal Dumping

Introduction

Litter and illegal dumping issues have plagued southeast New Mexico for decades. Dumped wastes include, but are not limited to: household waste, recreational waste, construction waste, sewage waste, agricultural waste, and industrial solid and fluid wastes.

This visual assessment guide only covers "bulk" solid and fluid wastes commonly found in the field in southeast New Mexico. "Bulk" wastes are typically dumped from larger transports and containers, then the transports or containers are driven off. Bulk wastes may be mineral materials, contaminated soil, powder or fluid chemical additives, wastewater, or fluid waste streams. The result is dumped masses of solid, semi-solid, or fluid materials, often in large volumes, that have no chemical labels or identifiers except the visual characteristics of the dumped material. Until lab tests can be run, first responders may need to make rapid visual assessments to report the dumps and to make preliminary assessments on potential hazards/impacts.

Bulk wastes are generated by different industries in the region but the majority come from widespread oil and gas operations, regional mining operations, and contractors and companies that support regional industries.

Limitations of This Visual Guide

Some naturally occurring oil and gas (O&G) waste materials have hazardous material characteristics. Crude oil and natural gas are toxic, flammable, and can be explosive under the right conditions. In addition to naturally occurring harmful materials, thousands of chemicals and additives are used in the oil and gas industry and each may have its own health impacts, environmental impacts, and hazard characteristics. The harmful and hazardous characteristics of man-made chemical additives are beyond the scope of this guide but may be present in bulk O&G waste dumps found in the field. All bulk waste dumps should be treated as hazardous until lab testing proves otherwise.

This guide focuses *only on some of the dumped bulk waste materials that are commonly encountered* in the field in southeast New Mexico. Dumpsites are sometimes impossible to visually assess as to material identity.

***Remember*:**

It is not as important to identify the dumped material as it is to report the location of the dump to the proper authorities.

The Colors of Illegal Dumping

Visual Assessment of Illegally Dumped Bulk Wastes on the Landscape

Accurate identification and assessment of accidental or intentional releases of waste materials on the landscape can only be achieved with proper sampling of the released material and lab analysis of the samples by a certified lab. With that stated, a site can be visually assessed and an initial report made on what the released material "looks like". It must be emphasized, however, that visual assessments are *never* worth putting your self at risk to obtain. Always remember: *only* lab analysis of released materials can determine what the released material actually "is" and the material may not be what it "looks like".

General Precautions and Safety Measures for Visual Assessments

- ALWAYS treat all material releases on the landscape from unknown and unverifiable sources as "hazardous materials". Only proper lab analysis can determine whether the material is hazardous or not.
- ALWAYS follow the three "R's" of proper site entry protocols for hazardous materials: **R**ecognize, **R**etreat to a safe distance, and **R**eport.
- ALWAYS observe from a safe distance and use a telephoto lens to document the release and any close-ups of the material.
- ALWAYS wear your H2S or 4-Gas monitor when working in, near, or around oil and gas active areas. If your monitor alarms, move crosswind and upwind and immediately evacuate the area. When you report the release, also report that your monitor alarmed.
- ALWAYS stay uphill and upwind of the released material to avoid any vapors or airborne particulates. If you can smell odors from the release, you are too close.
- ALWAYS prevent contact of the released material with your skin, hands, clothes, shoes, nose, and eyes.
- ALWAYS control ignition and spark sources. Some released materials may be flammable or explosive or may be "off gassing" entrained flammable gases. So keep a safe distance away that is upwind and uphill from the material.
- NEVER put your self at risk to assess or investigate a dump or release.
- NEVER approach an active release in progress, especially if it is from a well, pipeline, or wrecked trailer or tanker car.
- NEVER assume that a release is what you think it is; treat it as hazardous until proven otherwise.
- NEVER disturb, destroy, or remove physical evidence at the dump site. Avoid driving over vehicle tracks or stepping on, or adding to, footprints left at the scene.

Reporting Illegal Dumps

It can aid response and land management authorities if the following information is provided:

Where the release is located:

Latitude and longitude points in decimal degrees is preferred, but any legal description (township, range, section, and quarter/quarter), driving directions, nearby landmark, or closest well to the release will suffice. Each well has a well sign with the legal description of its location on the sign. Take a snapshot of the sign for reference and forward the sign to the reporting authority with directions to the release from the well sign location.

Whether the release is "active" or "not active".

An "**active**" release is a release that is still in progress, with more released material being added as time passes. *Immediately evacuate yourself from an active release site*. Active releases are the most dangerous releases and require immediate reporting. Note: *Only the operator of a well, facility, or pipeline can respond to an active release at their facility*. An "**inactive**" release is a release in which the source of the release has been "controlled" (shut off or terminated) and the released material is just sitting on the ground. Most illegal dumps are "inactive" releases by the time they are discovered.

General description of the release and material:

Sometimes, the best report that you can make is: "There is an inactive release 100 feet north from this location (lat and long) and I don't know what it is…it's an orange material covering approximately a 30x40 foot area." And that's a perfectly good report. You DO NOT have to be able to identify the material to report it—so *don't* put yourself at unnecessary risk attempting to do so.

Your name and cell phone contact information:

This is needed in case the responding authorized officer cannot locate the release on the ground. The more information you can give about the release location (ie., decimal degree point, the closest well, and driving directions), the more likely the responding officer be able to locate the release. One reason that dumps might not be found is a transposition or omission in the reported decimal degree numbers and no other location references provided in the report. If you can, try to give two different location references in the report and/or an aerial map with the release site indicated on the map.

Photos of the dumped material:

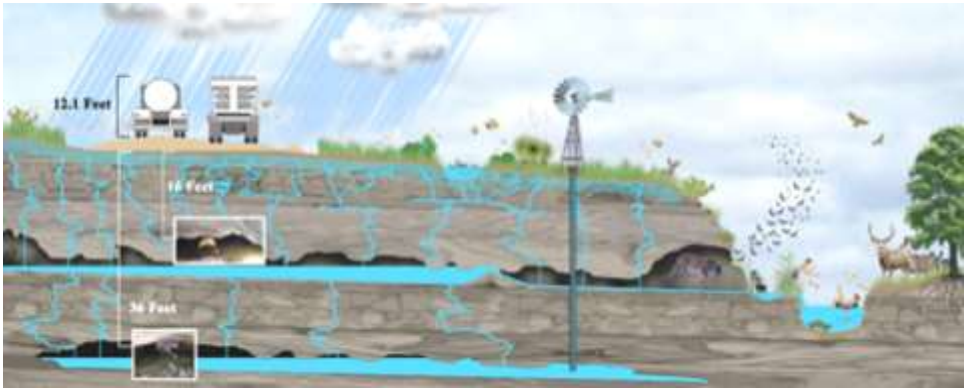
IF you can SAFELY take a photo of the dumped material ***without putting yourself at exposure risk***, take a snapshot from a safe distance with a telephoto lens and forward the photo to the responding authority.

Photos of an active illegal dump in progress:

IF you can do so *without incurring any additional risks to yourself,* photos and videos of illegal dumping activities in progress provide legal evidence that can be used to cite and/or prosecute illegal dumpers. Images of the door panels on the truck cab; the license plate of the vehicle or trailer; and documented proof of the release coming from the vehicle, trailer, or equipment provide evidence for cases.

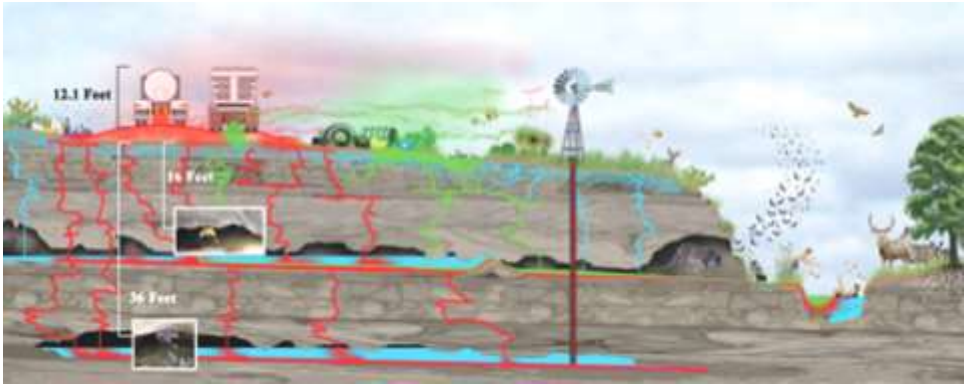
- Do NOT give high speed chase to dumping vehicles.
- Do NOT drive recklessly to obtain photos.
- Illegal dumpers know they are breaking the law and can get aggressive. Unless you are a law enforcement officer, do NOT directly confront illegal dumpers or try to stop the illegal dumping. Just discreetly take your photos *if it is safe to do so* and report the incident as soon as possible. Forward any photos or videos as evidence to the responding authority.

IMPACTS OF ILLEGAL DUMPING



Drinking Water and Surface Water Recharge in Southeast New Mexico

While the ground beneath our feet appears to be solid, in many cases it is filled cracks, fissures, sinkholes, sinking streams, springs, playa features, and holes that are collectively known as "karst". In karst areas like those found in southeast New Mexico, rainwater slowly percolates through surface karst cracks and fissures and into deeper underground voids, cave systems, and freshwater aquifers. In shallow water aquifer areas, aquifers may be as little as 16 to 36 feet below the surface, while other aquifers may be deeper. Numerous environmental concerns arise in karst areas due to the direct connection to freshwater aquifer recharge and to surface water that provides riparian wildlife habitat in a desert environment.



Dumping Impacts to Drinking Water Aquifers and Surface Water

All litter and illegal dumping can impact freshwater aquifers and surface water. But the biggest impacts occur from large volume bulk waste dumps that contain high levels of salt, harmful materials, heavy metals, toxic materials, and hazardous characteristic materials. Many man-made chemicals in waste dumps are lethal to aquatic life; can contaminate water supplies; impact soil and vegetation; and pose health hazards to livestock, animals, and humans.

IMPACTS OF ILLEGAL DUMPING

Impacts to Soil: Salt

Many industrial bulk wastes in southeast New Mexico are very high in salts. Drilling fluids, brine water, produced water, and brine cement in the region are up to five times saltier than ocean water. Solid waste dumps from potash and salt mining operations are also very high in salt. High salts sterilize topsoil, inhibit or prohibit seed germination, and change the characteristics of the soil (as pictured above). Since salt bonds with soil particles, these detrimental changes can be very long term, up to decades or more. Increasing impacts occur with repeated dumps in the same area.

Impacts to Soil: Other Bulk Waste Contaminants

Bulk waste materials containing man-made chemicals, naturally-occurring harmful contaminants, heavy metals, and environmentally persistent chemicals can severely degrade soil quality. Some contaminants will kill off soil microbes and vegetation; others can contaminate plants and any animals that eat what is grown in the contaminated soil. Any dumped waste that causes vegetation loss also creates rapid erosion of affected soil in wind events and in rainfall runoff. Rainfall runoff and erosion can carry soil waste contaminants into drinking water supplies and surface waters.

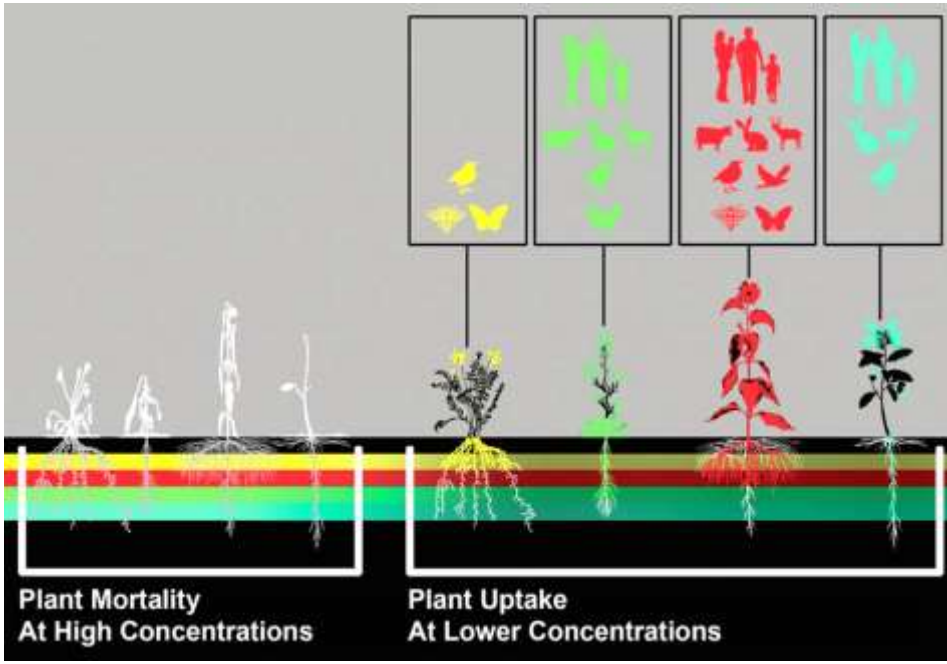
IMPACTS OF ILLEGAL DUMPING

Impacts to Vegetation: Salt

Waste dumps high in salt will cause vegetation die off. Die off begins within hours of the dump. When the salted waste is freshly dumped and begins to dry out, bright white salt crystals may form on the surface (left photo above). With time and weather moisture (dew, rain, fog, snow), the salts will begin to recede deeper into the soil. During droughts, salts will rise back up to the surface through capillary action and recede with weather moisture. Although salt crystals on the surface may diminish, the salts are still present in the soil profile and will prevent seeds from germination and vegetation from re-establishing. As the standing dead vegetation degrades and is blown away, the contaminated bare soil will erode and migrate during wind and rain events.

Highly saline waste dumps often create an area of dead vegetation and sterilized soil, which closely correlates with the original dump affected area. Even if visible signs of the waste dump have faded on the surface, the dead vegetation (or lack of vegetation) often serves as a permanent marker of where dumped contaminants still affect soil and prevent revegetation. Without site remediation, it may take years to decades for the vegetation to recover. Even if some vegetation does establish, the high salts in the soil will cause plant stunting, poor germination of seed, and plant die off in droughts. Meanwhile, salts leach from the dump site and into surrounding areas and waters.

IMPACTS OF ILLEGAL DUMPING



Impacts to Vegetation: Other Contaminants

Both salt and many other waste contaminants are lethal to vegetation in high concentrations. As contaminated rainwater leaves the dump site, it can impact other vegetation downslope of the original site. Even when contaminant levels are not high enough to cause plant mortality, many plants will uptake trace contaminants and accumulate contaminants in leaves, fruits, seeds, nuts, and/or roots that are in turn eaten by insects, animals, and people, passing the contaminants up the food chain. As shown in the above illustration, each plant species is unique about what contaminants it will uptake and where it stores the contaminants. Some plant species are "super accumulators".

IMPACTS OF ILLEGAL DUMPING

Impacts to Vegetation: Other Contaminants

The above images show a time lapse of vegetation impacts from a waste oil dump that had a high solvent odor, which is indicative other chemical additives in the waste. Even though high salts were not present, the "solvents" and other chemicals in the waste dump created a 3-acre vegetation dead zone in three weeks' time.

Impacts to Wildlife: Other Contaminants

Wildlife cameras were placed in the contamination zone of the above dump site. Despite the oily soil, oil-sprayed vegetation, and high solvent odor, animals continued to burrow, nest, sit/lay in the contaminants, and to forage contaminated seeds and vegetation in the dump-affected area. Basically, the animals continued to "go about their business" with little change in behavior. Consequently, the animals absorbed contaminants through fur, skin, and hooves and consumed contaminated forage. Animals captured on camera utilizing the contaminated site included (clockwise from left): deer, rabbits, pack rats, quail, porcupine, and mice. Health impacts to the animals are unknown.

IMPACTS OF ILLEGAL DUMPING

Impacts to Livestock and Wildlife: Consumption of Contaminants

Livestock and wildlife in desert regions are very opportunistic when it comes to anything that even resembles water or fluid and will flock to it in a short period of time Waste dumps are often consumed by livestock, wildlife, birds, and bats before the dumps have a chance to soak into the ground or dry. This includes pools of dumped waste on dirt roads (left) and pools of dumped waste in highway bar ditches (right). If roads have been repeatedly dumped on, even fresh rainwater pools may be contaminated.

Impacts to Livestock and Wildlife: Poisoning, Impaired Health, and Fatality

When poisoned, animals will instinctively head towards fresh water and shade, and may travel some distance away from the dump site. With ingestion of highly saline fluids, animals will first develop the scours (diarrhea) and undergo rapid dehydration. Pregnant animals can abort fetuses. High salts above 8,000 ppm can cause brain damage and rapid fatality. If waste contaminants are highly toxic (glycol, methanol, etc.), the animals may only make it a few yards from the waste dump and die. If the animal survives the poisoning, contaminants in dumped waste may cause long-term health effects and organ damage. If the contaminated animal expires, contaminants in the carcass can be passed to predators and scavengers.

IMPACTS OF ILLEGAL DUMPING

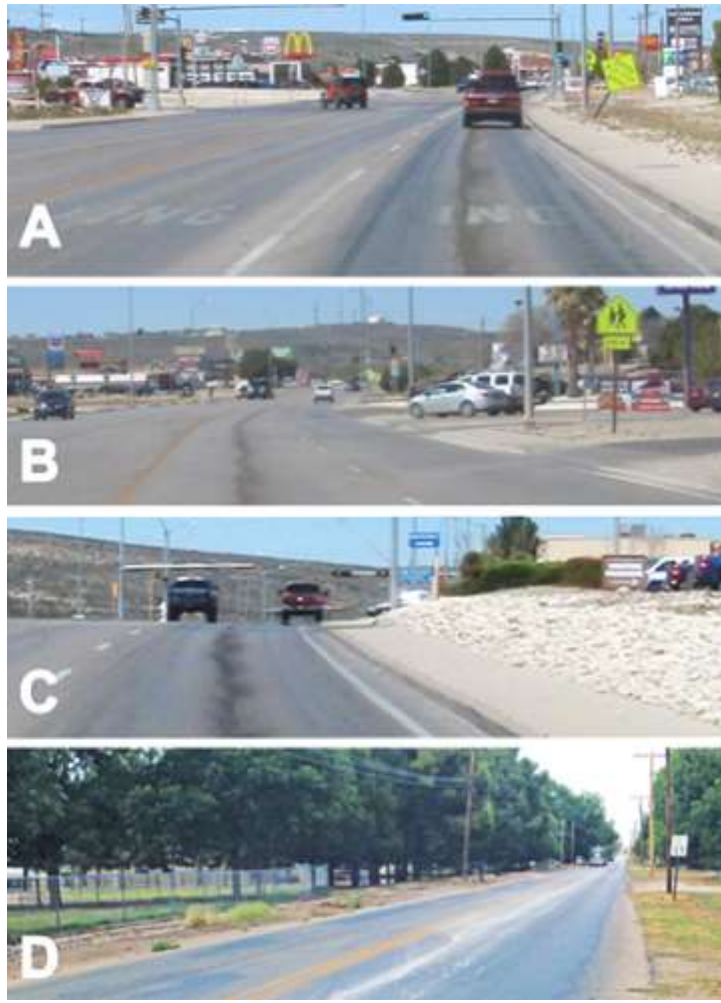
Impacts to Birds, Bats, and Pollinators

Birds, bats, and insects are attracted to pools of waste oil, produced water, and other watery fluid wastes because they resemble pools of freshwater. When birds, bats, and other animals land on or jump into pools of waste oil and other hydrocarbons, they sink and "drown" in the oil (the water in the animal is heavier than the oil) as pictured in the photo above (left). When birds, bats, and insects (picture above right) land on and drink highly saline waste fluids, mortality often follows. Unlike mammals, it takes just drops to a teaspoon of fluid to poison insects, bats, and birds due to their small size.

Impacts to Air Quality

Fluid waste dumps on soil saturate the soil and eventually dry out. Salts and other contaminants will bond with soil particles. Even fluid waste dumps on pavement dry out, leaving dried contaminants on the surface of the pavement. Contaminated dusts from soil and pavement waste dumps can become airborne in wind events and travel long distances from the original dump site. Contaminant dusts can coat previously unaffected soil and vegetation (which impairs plants' ability to "breathe" CO2, exhale oxygen, and survive) and are breathed in by animals and humans. Waste dumps on paved and unpaved roadways are especially harmful because road traffic constantly disturbs and further powders the dumped contaminates and lifts the contaminated dusts higher into the air column, resulting in greater distribution of the contaminated dusts over greater distances. In the above photo, dusts from produced water, waste oil, and drilling fluid dumps (identified by the various soil stain colors in the lower right of the photo) are raised up into the air by passing vehicles. Rainwater runoff from this dump site will also transport contaminated particulates into surface and groundwater.

IMPACTS OF ILLEGAL DUMPING



Public Health and Safety Impacts

According to DOT, waste materials dumped on and near roadways increase the potential for highway accidents and fatalities. Dumped fluid wastes that contain oil, trace oil, and frac gels can rehydrate during rain events, increasing the potential for loss of vehicle control, inability to stop, and accidents/fatalities. Industrial bulk wastes may contain naturally occurring and man-made chemical contaminants that are toxic, harmful, have hazardous characteristics, and/or are harmful to human health. Illegal dumps of industrial waste streams are occurring out in the field in remote areas as well as in populated areas. In the photos above:

A.) A waste dump through a school bus stop;
B.) A waste dump through a school crossing zone;
C.) A waste dump through a hospital emergency entrance;
D.) A waste dump through a residential and agricultural area with some agriculture (pecan orchards) intended for human consumption.

Illegal waste dumps increase both physical public safety hazards and well as human health hazards.

COMPONENTS OF OIL AND GAS (O&G) WASTE STREAMS

Naturally Occurring O&G Waste Components

Crude Oil Components: Crude oil may contain but is not limited to: methane, ethane, propane, pentane, hexane, BETEX (benzene, toluene, ethylbenzene, and xylene), naphthalene, phenathrene, anthracene, cyclopropane, cyclohexane, cyclobutane, asphaltics, asphaltenes, maphthenic acids, heavy metals (cadmium, chromium, copper, lead, mercury, zinc, iron, nickle), NORMs (naturally occurring radioactive materials), sulfur, hydrogen sulfide, mercaptans, and organic compounds of nitrogen and oxygen. Is flammable and can be explosive.

Gas Components: H2S (toxic gas), methane, propane, ethane, pentane, hexane, BETEX, nitrogen, oxygen. Gas components are flammable and may be explosive.

Produced Water Components: Produced water may contain, but is not limited to: 133,000 ppm or more of dissolved salts (5X the salinity of seawater); high sulfate levels; BTEX (benzene, toluene, xylene); Hydrocarbons (in diesel, gasoline, and heavy hydrocarbon ranges); naturally occurring radioactive materials (NORMs); a wide variety of man-made chemicals; entrained gases like H2S, methane, etc.. If enough gases and hydrocarbons are present, may be flammable or explosive.

Man-made Chemical O&G Waste Components

Drilling Fluids and Cuttings: Drilling fluids may contain, but are not limited to: bentonite clay (can cause silicosis; listed carcinogen); heavy metals; polymers; brine water or fresh water fluid base; fibrous or bulky fluid loss control materials; a wide variety of other man-made chemical additives to enhance drilling performance in different types of formations/conditions. Some drilling fluids may have a diesel base rather than water or brine. Drilling fluid additives may: have health effects; be toxic; be endocrine disruptors (affect the ability to reproduce and viability of offspring); target organ systems; may be carcinogenic or mutagenic, and may be environmentally persistent.

Coated frac sand: Coated frac sands may contain, but are not limited to: polymers, Teflon, plastic coatings, enhanced radioactive tracers, and any of a host of chemicals that facilitate the fracking process. Some coatings are water soluble; others are not. Some frac sand coating chemicals may: have health effects; be endocrine disruptors (affect the ability to reproduce and viability of offspring); target organ systems; may be carcinogenic or mutagenic, and may be environmentally persistent.

Uncoated frac sand: May contain silica, which can cause silicosis and may be a carcinogen.

Frac Fluids: Currently, thousands of chemicals are available to make up unique and proprietary blends of frac fluids. Frac fluids are typically a “chemical soup” made up of many different chemical components that may contain propriety mixes of polymers, acids, and multiple chemical additives. Some frac chemicals may: have health effects; be endocrine disruptors (affect the ability to reproduce and viability of offspring); target organ systems; may be carcinogenic or mutagenic, and may be environmentally persistent.

Production Chemicals: A large array of chemicals and chemical blends are available to enhance well performance and production. Production chemicals may: have health effects; be toxic; be endocrine disruptors (affect the ability to reproduce and viability of offspring); target organ systems; may be carcinogenic or mutagenic, and may be environmentally persistent.

SOLID BULK WASTE DUMPS

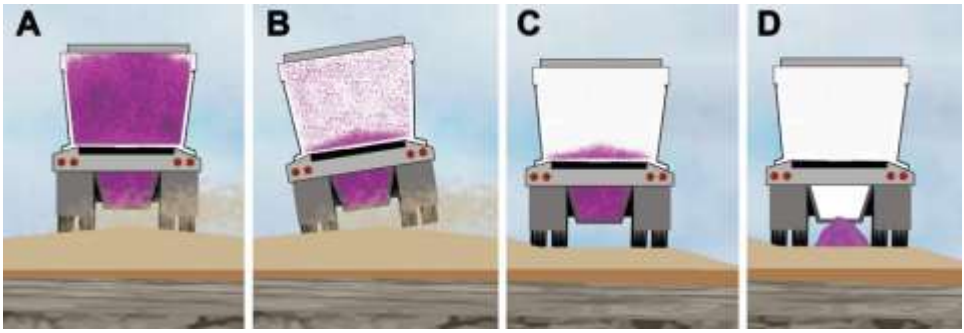
Solid waste dumps may contain unwanted clean solid materials (caliche, gravel, topsoil, salt, potash, etc.) or contaminated solid waste materials (coated frac sand, contaminated soil, drilling muds/cuttings, etc.). Clean or contaminated, once solid materials are dumped it becomes illegally dumped waste. Any transport or container that can hold solid materials may dump solid waste materials. Common solid material transports include: belly dump trucks, dump trucks, open topped frac tanks, frac sand transport containers, and rolloff bins of various sizes and designs.

Solid waste dumps may occur accidentally or on purpose, but the results are the same: large volumes of dumped solid materials. Solid waste dumps on or near roadways, whether clean mineral materials or waste solids, can pose significant road and health hazards for other drivers. The above photo is of a salt dump on a highway.

Belly Dump Truck Trucks: Solid Waste Dumping Patterns

Intentional solid waste dumps from belly dump trucks (that have hatches in the bottom of the material container) often have a larger dump pile at the beginning of the dump run, with a long "thin" trailing cargo/waste stream extending for some distance in the direction of travel. The bottom photo is an intentional coated frac sand dump from a belly dump truck, with a thinner trail of waste that extended for several miles leading in the direction of travel through high cave/karst terrain.

SOLID BULK WASTE DUMPS



Solid Waste "Shakeout" Dumping

Solid material haulers often cannot pick up a load of a different material to haul until the "shakeout" from the previous material has been cleaned out. In the above illustration:

A.) The solid material transport hauls coated frac sand to a well completion site;

B.) After the majority of the material has been delivered at the site, the driver drives off with remnant materials still clinging to the sides and bottom of the transport;

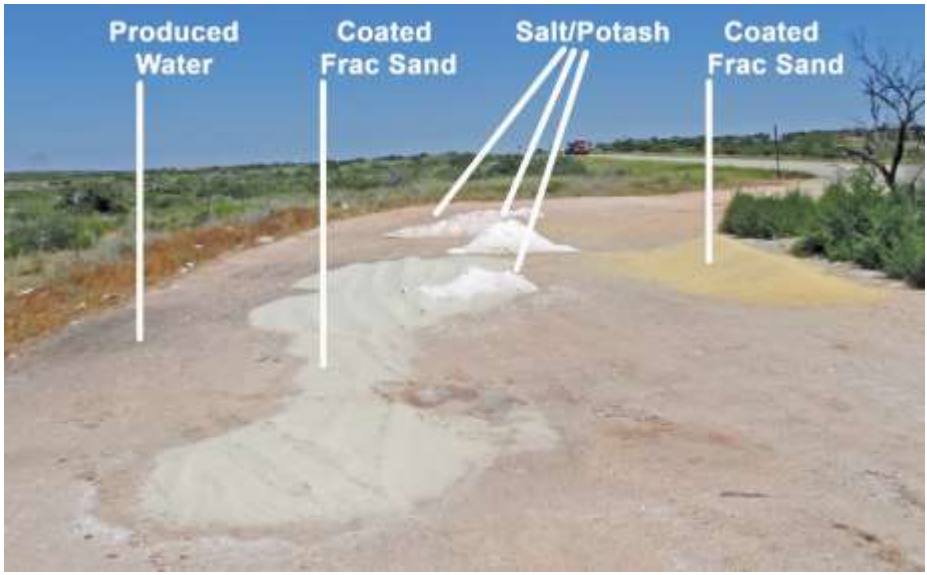
C.) The vibration of driving "shakes" the remnant materials down to the bottom of the transport; and

D.) The driver pulls off on a shoulder, highway pullout, other biway, or pasture, opens the dump doors on the bottom of the transport container, and illegally dumps the waste "shakeout" materials.

Multiple "Shakeout" Waste Dumps from a Belly Dump Truck

Several cubic feet to cubic yards of waste material can be dumped at each "shakeout" dump. At least two separate "shakeout" dumps of frac sand were made at the site pictured above either before or after produced water was dumped at the same site.

SOLID BULK WASTE DUMPS

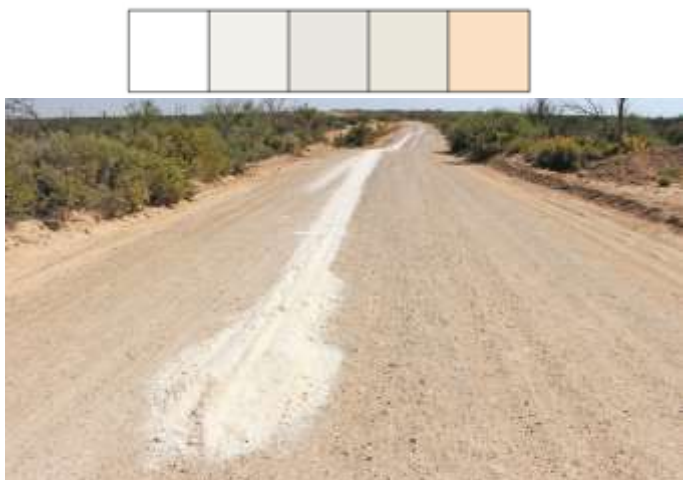


Multiple "Shakeout" Dumps in One Pullout

Above photo is of multiple "shakeout" dumps of various materials in one highway pullout. Highway pullouts in southeast New Mexico are often coated with repeated waste dumps of various materials over time. Note the dead vegetation to the left (downslope) of the pullout, indicating plant toxicity.

Salt and Potash Waste Dumps

While salt and potash are naturally occurring mineral materials that are regionally mined, both are very high in salts that can be lethal to soil microbes, plants, and animals in concentrated amounts. Both can contaminate water supplies. Both salt and potash waste dumps may be fine granules to coarse granules (like rock salt). Salt and potash waste dumps may range in color from "white" to a very light "greyish" to "pinkish"



Pictured above: a bulk waste salt or potash dump near a Pecos River low water crossing. Note larger dump at the beginning, with a thinner trail in direction of travel.

SOLID BULK WASTE DUMPS

Powdered Oil and Gas Solids

The oil and gas industry uses a wide variety of chemicals, additives, and materials in "bulk". Large volumes of materials may be transported in sacks on pallets or in "sackless" bulk containers. Solid materials from both may be dumped on the landscape. Common bulk materials include drilling mud mixes, cement, caustic, fibrous loss control materials, other drilling mud additives, frac sand, and other fracking materials. In the above photo, two different solid wastes are dumped in close proximity to each other. The grey material is "fibrous and fluffy". It *may* be drilling fluid "loss control materials" (LCM). The white powder material *may* be caustic or any other white powder additive or chemical. The materials should be treated as hazardous waste until proven otherwise.

Oil and Gas Drilling Cuttings Solid Bulk Waste

In drilling a well, well bits bore through and grind up rock formations. Rock cuttings are brought to the surface with drilling muds. Muds are removed from the cuttings and recycled. The "mostly dry" cuttings are then stockpiled to dispose of as waste. Cuttings can be small to medium size pieces of rock intermixed with muds; range in color from light grey to almost black; may contain hydrocarbons, NORM's, high salts, drilling muds, entrained gases, BETEX, and drilling mud additives. Can contaminate soil, plants, animals, and water supplies and has various health hazards.

SOLID BULK WASTE DUMPS

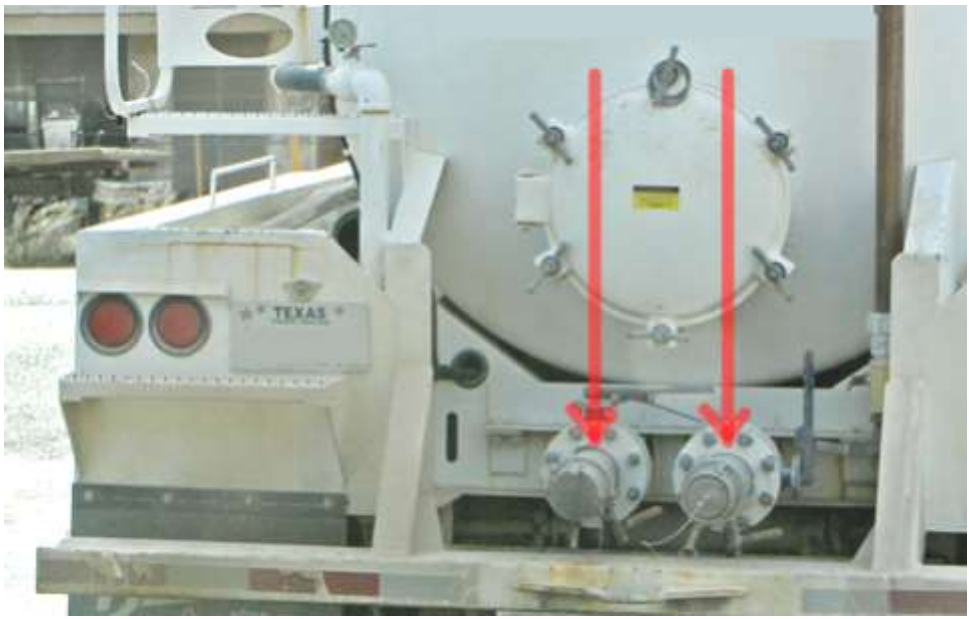
Contaminated Soil Waste Dumps

It is impossible to determine what is in contaminated soil waste dumps without lab analysis, but the presence of heavy black, blue, or white plastic sheeting in the dump is an indicator that the dump originated from a fluid waste cleanup or oil and gas lined tank battery or reserve pit. This dump has grey "drilling fluid" staining along with darker "oil" staining, as well as salt crystals and salt affected soil around the dump (washed out of the soil in rain events). This dump was a "tip dump" from a dump truck or other solid waste container and most likely contains oil and gas contaminated soils from a cleanup site. What was cleaned up is unknown and may have been harmful or hazardous materials.

FLUID WASTE DUMPS

Like solid waste dumps, fluid waste dumps can originate from any truck or container that can hold fluid. This includes but is not limited to: tanker trucks, "honey" trucks, chemical transport trucks, service trucks, frac trucks/pumps/tanks, cement trucks, frac tanks, rolloff bins, plastic tanks, cube containers, portable toilets, vehicle fluid reservoirs, five gallon buckets, etc.. Some of the largest fluid dumps come from tanker trucks that transport 120 to 140 barrels of waste.

FLUID WASTE DUMPS



Tanker Trucks: Proper Valve Closure and Valve Capping During Transport

During transport, both the valves on the rear of a tanker trucks (red arrows) should be fully closed and have no fluids dripping, leaking, or discharging from the valves. In addition, safety caps should be screwed onto the valves to ensure cargo containment and safety chains attached to the caps as shown in this photo.

Dumping During Transport: Tanker Trucks

Left Photo: A tanker truck with both valve caps off and discharge valve open as it drives down a roadway during an illegal dump. **Right Photo**: A tanker truck with valve caps removed and "dribble dumping" from a discharge valve that is only partially open. Dribble dumps will still discharge the entire contents of the tanker; it just takes longer, spreading the dumped contaminants over more miles and impacting the environment and human health and safety for the longer route.

FLUID WASTE DUMPS

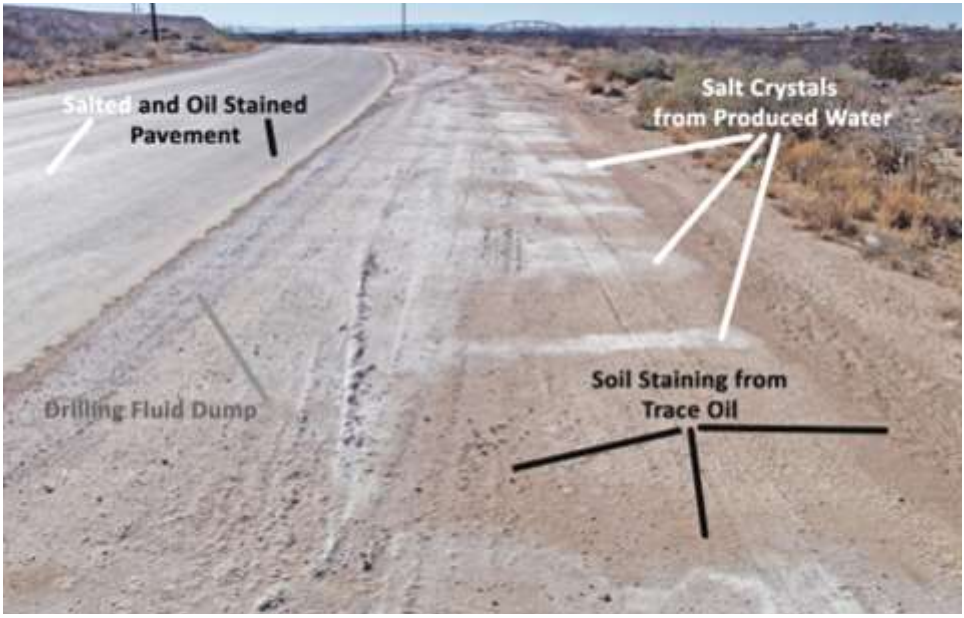
Dumping During Transport: Tanker Truck

The above photo documents an illegal dump during transport of produced water with trace oil. In dumps during transport, the dumper typically stops in the road, or pulls off on the shoulder, and opens the valves on the back of the truck. Then, the driver drives down the roadway, discharging waste. The above dump happened very recently because there are still some shallow pools on the roadway. If the dump is tracked from it's point of origin to final destination, it may sometimes (but not always) indicate the origin or destination of the dumper. However, many dumps during transport just begin on or beside the road and end when the waste material is fully discharged. As dumps are driven over by other traffic, the dried materials will powder, become airborne, and the dump will become less visible on the roadway over time.

Dumping During Transport: The Beginning of the Tanker Truck Dump Run

Due to the amount of time it takes to open the rear manual discharge valves on a tanker truck, get into the cab of truck, and drive off, the beginning of the dump run typically has a larger pool of dumped materials. In cases where repeated illegal dumps occur in the same area, the volume of dumped materials can be approximated by counting the number of "dump start pools" and multiplying it by the average tanker truck volume.

FLUID WASTE DUMPS



Dumping During Transport: Repeated Tanker Truck Dumps on Same Roadway

The above photo documents repeated dumps during transport on the same several mile stretch of roadway, very close together in time. Since the dumps cover the roadway and easements with large amounts of fluids, it makes it impossible to "count" how many dumps have occurred. Best estimate based on volume, distance, width, coating, and runoff: approximately 30 dumps. Repeated transport dumps are often located near active drilling or well completion sites. In this case, drilling fluids (grey material) and brine range produced water with trace oil can be visually identified. Frac fluids may also be present. The multiple dumps also crossed a Pecos River bridge—with waste loads dumped over the bridge and into the Pecos. Fresh dump runoff ran into the road ditches (pictured) in large enough volumes to run off into ravines that led to the river as well. Contaminants will also be washed into the river with rain events. So in this case, it is known that the dumps had a direct impact on surface water.

Stationary Dumps: Tanker Truck

Stationary dumps occur when the truck or containment is parked and all waste is dumped in one spot. Waste may pool or run off from the discharge site, depending upon slope and terrain.

FLUID WASTE DUMPS

Stationary Dumps: Tanker Truck "Washout" Holes

When tanker trucks park and discharge from rear valves or hoses from the back of the truck, the discharged fluids come out under high pressure, which creates a "wash out hole" from the force of the fluid discharge hitting the soil surface. Washout holes vary in size due to variations in discharge pressures and duration of discharge. Holes can be about six inches in diameter and shallow to over two feet across and three feet deep, excavating soil and exposing deep plant roots (as pictured above). Wash out holes can be created from rear valve discharge, or from a length of hose attached to the valve, with the end typically laid out into adjoining pasture. Based on the distance of the discharge hole from the vehicle rear tracks, the above washout hole was created by a length of hose. The dump on this location was an older dump site that was found out in the field due the surrounding dead vegetation. The washout hole confirmed it as a dump site; the dead vegetation indicated it was a heavily salt affected soil site. Lab analysis of soil samples confirmed this assessment.

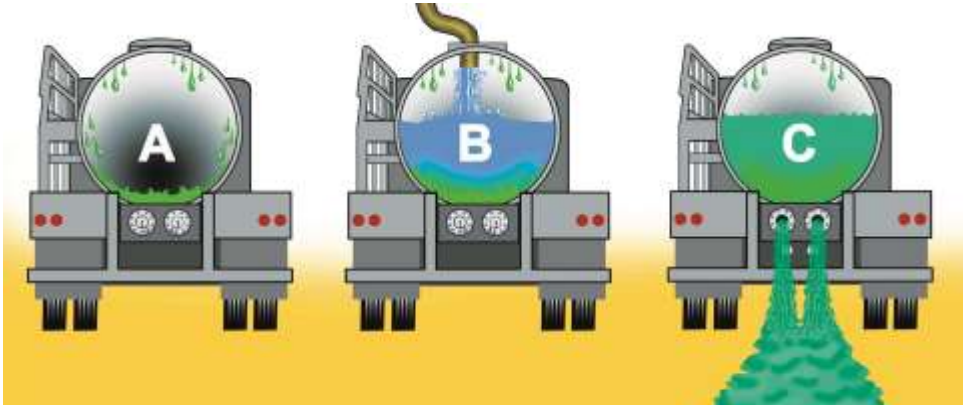
Poor Truck Maintenance Dumps: Tanker Trucks

Poorly maintained tanker trucks can dump waste materials throughout their driving route. If it's a daily route, dumped contaminants can add up to significant volumes over time. Leaking tanker trucks should be taken out of service and cargos transferred to other trucks/containment before being moved from the site.

FLUID WASTE DUMPS

Malfunctioning Float Valve Dumps: Tanker Trucks

Poorly maintained float valves can create gallons to barrels of dumped waste every time a tanker truck brakes, accelerates, or turns along its entire driving route. This can result in large volumes of dumped waste over time. Float valve dumps are hard to see when tailing the vehicle, because the dumped waste originates from under the tanker truck rather than from back or side valves. Trucks with malfunctioning float valves should be taken out of service and cargos transferred to other trucks/containment before being moved from the site for repair.



Rinsate (Washout Wastewater) Dumps: Tanker Trucks

Tanker trucks can be hired to haul any fluid. A tanker truck that hauls waste materials cannot haul clean materials without first cleaning out the residual waste in the tanker (A). To do so, the tanker interior is filled with a quantity of freshwater (B). This "dilutes" the waste in the tanker, but the resultant combined fluid is *not* freshwater; it's contaminated wastewater—as such, it must be disposed at an authorized and permitted disposal facility. Instead of properly disposing of the waste, dumpers will open the valves on the tanker and illegally dump the wastewater (C). Over time, entire tanker loads of undiluted waste are dumped, just portions of tanker loads at a time. An additional problem is that many illegal rinsate dumps occur in close proximity to freshwater stations, which are often located near surface waters or in shallow aquifer karst terrain. Among other impacts, contaminates from rinsate dumping can contaminate surface and groundwater.

FLUID WASTE DUMPS

Stationary Dumps: Frac Tanks

Frac tanks are used extensively in the oilfield and may contain, but are not limited to: bulk solid materials, frac acid, frac gel, frac brine water, produced water, drilling fluids, cuttings, contaminated soil, sewage, etc.. Frac tanks may be cylindrical (like those pictured) or rectangular boxes mounted on skid structures. Like any truck or containment, materials can be dumped from frac tanks. In the above case, valves were opened on frac tanks and waste fluids allowed to flow out into the adjoining pasture. Just like with tanker trucks, frac tanks that held waste cannot be used for clean materials until the tank has been cleaned; so contaminated rinsate (washout wastewater) dumping from frac tanks also occurs. All rinsate and wastewater should be properly disposed at an authorized disposal facility.

"Tipped" Dumps: Frac Tanks

In this "tipped" dump, a rectangular frac tank was winched off the back of a flatbed hauling trailer until the tank tipped off and the back edge of the tank came in contact with the ground. Then, taking advantage of the tipped angle of the tank, the driver opened the valves on the tank and discharged the tank's waste on the roadway. This process left the outline of the rectangular frac tank in the discharge pattern (top of dump). When the tank was emptied, the driver winched the tank back up on the trailer and drove off. .

FLUID WASTE DUMPS

Failed Containment Dumps

Leaking, damaged, and faulty containment leads to illegal dumping of waste loads on parked locations and throughout the entire transport route. Liquid and semi-liquid wastes should not be put in any container that is not leak-free. Failed and leaking containers should be red-tagged and not moved or transported until leak free containment arrives to offload the contents of the failed container. Released contaminants on the ground must be cleaned up.

Failed Containment Dumps

This seven mile stretch of highway has been dumped on repeatedly by transports carrying leaking drilling fluid containers (frac tanks or rolloff bins). Although each container wasn't "leaking a lot", the cumulative result is a significant dump zone that extends seven miles through high cave/karst terrain.

FLUID WASTE DUMPS

Dumping During Transport: Smaller Chemical Containers

The above photo documents illegal dumping during transport from a plastic container mounted to a flatbed trailer (yellow arrow points to fluid releasing from an open valve on the container). The unmarked container may contain freshwater or harmful/ hazardous materials in either concentrated or diluted amounts. Just because the container is unmarked doesn't mean that the fluid is harmless. The size of the containment and the quantity of material being dumped doesn't matter: it is still illegal dumping. Further, any fluids dumped on roadways (freshwater or not) creates hazards for other drivers.

FRESHWATER versus BRACKISH WATER, PRODUCED WATER, BRINE WATER and MAN-MADE BRINE

It is permissible for oil and gas (O&G) operators to use freshwater for road and pad construction projects as well as dust abatement on heavily trafficked dirt roads. Freshwater is defined by the USGS as 1,000 ppm TDS or less. Water at this level of salt does not pose a risk to plants, animals, soil, or livestock.

However, illegal dumpers often take advantage of the freshwater application to roads and pads and "mimic" permitted freshwater applications as they illegally spray or dump highly saline produced water or contaminated transport container washout water on roads and pads. Some may also use the cheaper and more readily available produced water instead of freshwater in construction projects. The use of wastewater and O&G produced water in construction or dust abatement projects is a violation of state and federal O&G regulations.

FRESHWATER versus BRACKISH WATER, PRODUCED WATER, BRINE WATER and MAN-MADE BRINE (cont.)

Produced Water and Brine

Produced water is brought to the surface from oil and gas formations and contains salts, hydrocarbons, benzene, other naturally-occurring harmful materials, and any man-made chemicals used in drilling and production operations. Produced water is not "just water"; it is a "waste" material that can be harmful to human health and the environment and that must be properly contained and properly disposed at authorized facilities. In the Permian Basin, produced water salts can range from "brackish" range (35,000 ppm TDS) to "brine" range (133,000+ ppm TDS). As a general rule, Permian Basin produced water is five times saltier than seawater—or greater. Permian Basin produced water is so high in salt content that it is toxic and potentially lethal to soil microbes, plants, and animals.

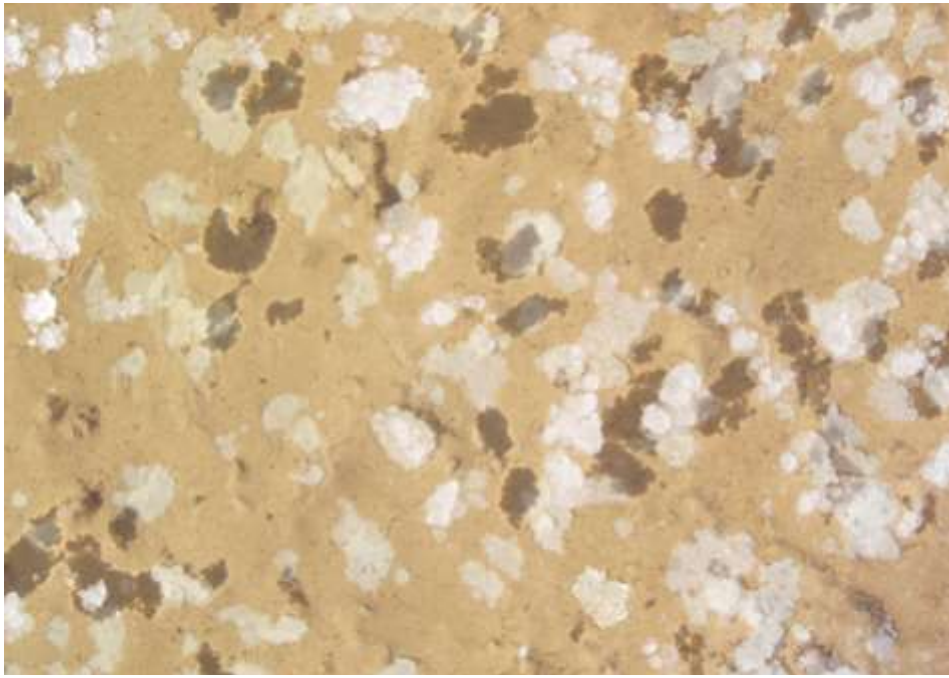
While produced water in the Permian Basin is often in the "brine" range of salts, *all produced water* also contains contaminants from formation materials (oil, gas, and other naturally occurring materials) and man-made additives used in exploration and production processes. These impurities cause problems when produced water brine is used as a brine medium to make up drilling muds and completion fluids. Consequently, freshwater and salt is often combined to create "man-made brine", which is used as a impurity-free brine for drilling muds and fluids. A recent alternative to "man-made brine" is produced water that has been "treated" to remove undesirable impurities other than salt and water. Due to the high salt content alone (ignoring all other man-made additives and naturally occurring contaminants): produced water brine, "treated" produced water brine, and "man-made" brine—as well as drilling and production materials made up with brines, such as "brine" drilling mud and "brine" cement—are all harmful or toxic to the environment when illegally dumped.

Determining the Difference on the Ground

When a water dump is "new" and very fresh, there may not be an immediate "visual" difference between freshwater, brackish produced water, brine range produced water, "treated" produced water brine, and "man-made" brine water—but there is a great

difference chemically. Recent produced water dumps may or may not have a strong "rotten egg" (H2S gas), solvent (benzene), or oil (hydrocarbon) odor; whereas, freshwater and man-made brine releases may have no odor or a milder sulfur and mineral smell. Sampling and lab analysis is the only way to accurately verify if the dumped material is freshwater, formation produced water, or man-made brine water.

Lacking a full sample analysis, one can return to the site in a day or two and examine the release area. Freshwater will NOT leave salt crystals on the surface of the soil as it dries out; produced water, or brine with a high salt content, will. If the ground is covered with white crystals that sparkle like "snow" in sunlight, the dumped material has very high salt content and is probably brine range produced water or man-made brine. Moderate salt crystallization on the soil surface is indicative of produced water in the brackish range. Some or low salt crystallization may or may not be indicative of produced water and chemical analysis is required to see if other materials associated with producing formations are present (sulfates, particular types of salts, trace hydrocarbons, BTEX, or frac fluids). Absence of salt crystals and other salt-affected soil effects is indicative of freshwater.



Floating Salt Crystals in Recently Dumped Brine Water

"Brines" are so high in saturated salt content that salt crystals may begin to form and "float" on and in the dumped fluid even before the fluid dries out or soaks into the soil. In this image: floating salt crystals are white, salt crystals suspended in the 6" deep dump pool are cream colored, and the shadows of the salt crystals on the bottom of the pool are dark. Since this brine dump is still liquid and pooled, the dump occurred very recently, probably within hours even minutes of the discovery.

DUMPS ON THE GROUND

Produced water with a high salt content (brine range produced water)

Description:

Clear and colorless fluid; saturated soil that may be darker from hydration but has no other discoloration; has white crystals that "sparkle" in sunlight appearing around the edges of a drying pool of clear fluid:

Potential Hazards:

The above photo of a produced water dump on heavy, slow-drying clay soil is a good example of how salt crystals (middle of photo) form around the edges of a drying pool (top of photo) of brine range produced water and how over time and with weather moisture the salt crystals begin to recede into the subsoil (bottom center of photo). Receding salts will at first leave a whitish "not sparkly" cast to the soil surface, before receding completely and returning "normal" soil coloration to the surface. The soil is still highly salty and will exhibit other salt-affected soil characteristics, but the visual "white crystal" cues to the degree of salinity are diminished at the soil surface. Salt in high concentration is toxic to soil microbes, insects, aquatic life, birds, wildlife, and livestock. Produced water can also contain cancer-causing man-made chemicals, hormone disruptors, and chemicals that target organs. May have a high odor. May contain H2S or other gases that can "gas off" as the dumped fluid dries. If present in high enough concentrations, gases may be flammable and/or explosive under the right conditions. Highly corrosive to metal.

DUMPS ON THE GROUND

Produced water with a high salt content
(brine range produced water; dried; one week old)

Description:
White crystals that "sparkle" in sunlight sitting on the surface of the soil with no other material present underneath the crystals.

Potential Hazards:
Note the dead vegetation in the dump zone of the above photo. The presence of dead vegetation in an area is a permanent visual indicator of a highly saline waste dump even after surface salt crystallization has receded into the subsoil. Salt in high concentration is toxic to soil microbes, plants, insects, aquatic life, birds, wildlife, and livestock and if not cleaned up can continue to affect soil and vegetation for many years. Produced water can also contain cancer-causing man-made chemicals, hormone disruptors, and chemicals that target organs. May have a high odor. May contain H2S or other gases that can "gas off" as the released fluid dries. Highly corrosive to metal. When fully dry, highly saline produced water and brine dumps resemble "snow" on the ground. With more age and weather moisture (dew, fog, rain), the salt crystals on the soil surface will recede into the subsoil, where the salts can remain for decades preventing vegetation growth and potentially leaching into surface and groundwater over time. Salt in the soil will visibly alter soil structure and create "fluffing", "pie crusting", and other soil structure effects that can be used to visually track "salt affected soil" sites even after visible salt crystals recede.

DUMPS ON THE GROUND

Bulk bentonite clay mix for making up drilling fluids (bulk dry cement looks very similar)

Description:

Light gray to dark gray, dry, very fine grain, very powdery material that is easily and readily airborne; bulk bentonite clay can have the consistency of baby powder (very light and fluffy). Bulk dry cement looks almost identical in color but is not as "fluffy" in consistency as bentonite clay. Both have similar hazards.

Potential Hazards:

In its naturally occurring state, bentonite clay is an inert and generally non-toxic material; however, it can cause silicosis and is listed as a carcinogen. Further, manufactured bentonite-based drilling mixes are not "just" bentonite clay, but a combination of bentonite clay with other proprietary man-made additives. Some bentonite drilling mixes used regionally have lab tested as very high in heavy metals, which is a particular concern to surface and groundwater. Additional chemical additives in bentonite mixes can be cancer-causing, hormone disruptors, or harmful to animal and human health. When encountering dry and powdered bentonite mix dumps on the landscape, treat all dumps as if they have other additives; do not breath dusts. Be especially cautious if working on or around old reserve pits, which have large quantities of bentonite clay and additives. Due to the fine clay structure, bentonite clays released in or near waterways can suffocate aquatic vegetation and coat fish gills.

Bulk Cement:

Bulk cement dumps can look almost identical to bentonite clay dumps. Bulk cement can be caustic, even without other chemical additives. Both cement and bentonite clay can cause silicosis (lung damage). Stay upwind and avoid breathing airborne dust.

DUMPS ON THE GROUND

Brine cement truck rinsate (watery and thin as pictured) or brine cement (thick and clumpy)

Description:

Medium to dark grey base material made into a slurry with brine water; may be viscous and clumpy (initial mix dumps) to thin and watery (typically cement truck rinsate); white crystals that sparkle in the sun appear around edges of drying or on surface of dried material.

Potential Hazards:

Brine cement dumps can vary from thick and clumpy piles of material that stand well above the soil surface (cement dumped undiluted from a cement truck) to a watery grey fluid that dries to a thin grey coating on soil and rocks (dumped cement truck wash out water). Brine cement dumps closely resemble brine drilling mud dumps, the primary difference being in the hardness of the dumped grey material when it dries. Clumps and piles of cement dry to rock hardness and piles of brine drilling mud dry to a more easily crumbled "hard clay" consistency. Salt in high concentration is toxic to soil microbes, insects, freshwater aquatic life, birds, wildlife, and livestock. Cement can be caustic, causing burns and irritation to the skin. If the cement was circulated downhole and returned to surface, it may have a high odor and may contain H2S or other production formation gases that can "gas off" as the released fluid or semi-solid material dries. Salt is highly corrosive to metal. With more age and water moisture, the salt crystals that form on the dried material surface will recede into the cement and subsoil, where the salt prevents vegetation growth and potentially leaches into surface and groundwater.

DUMPS ON THE GROUND

Brine based drilling fluids
(looks very similar to brine cement dumps, previous page)

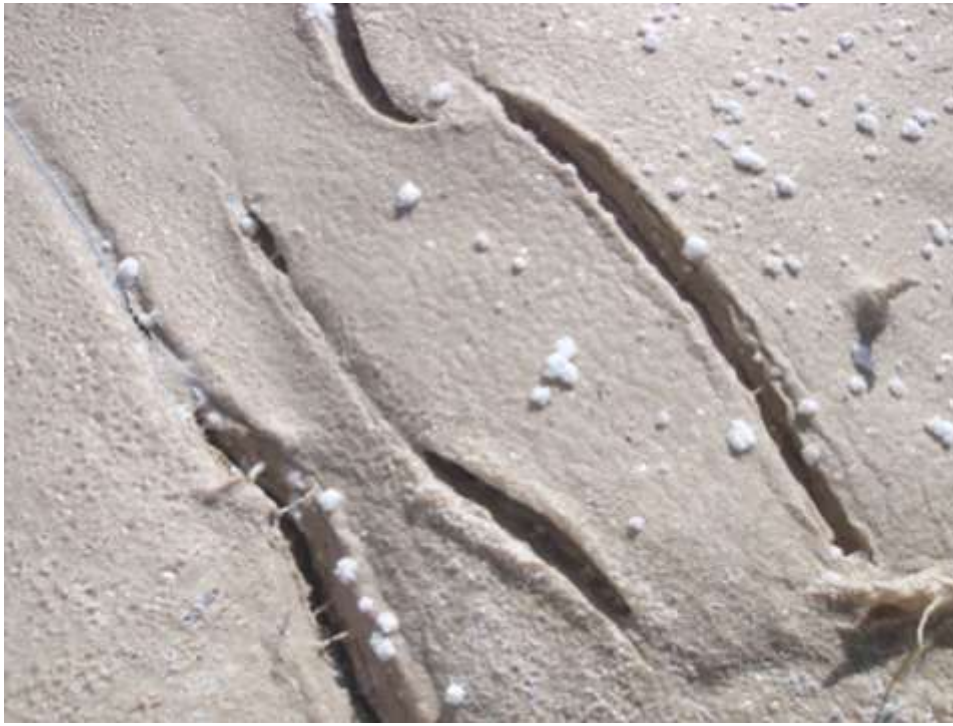
Description:

Light to dark gray, fine particle base medium (bentonite clay) made up with brine range salt water; fluid to semi-solid material that exhibits white salt crystals around the edges or on the surface when dry, but that can be broken up (not hardened material like dried cement). Note: the "gravel" in this photo is not part of the dumped material; it is what the drilling fluid was dumped on.

Potential Hazards:

Brine drilling mud dumps can vary from viscous flowing piles of semi-solid material (dumped undiluted from frac tanks and other containers) to a watery grey fluid that dries to a thin grey coating on soil and rocks (dumped transport container wash out water). The pictured dump was a thick fluid when dumped with a high bentonite clay content. Caustics and other harmful chemicals are frequent additives to drilling muds. Drilling fluids contain a variety of chemical additives that can be cancer-causing, hormone disruptors, or harmful to animal and human health. Drilling fluids can contain caustics that burn and irritate skin and membranes. Chemicals and salts in drilling fluids can contaminate water supplies. Drilling fluids can contain entrained gases, including H2S. Note the bird tracks made in this dump when it was fresh. Animals are highly attracted to fluid and semi-fluid waste dumps and will consume the fluid. High salts in any dump can be lethal to birds, bats, other animals, plants, and soil microbes.

DUMPS ON THE GROUND



Brine based drilling mud
(still hydrated and not fully dry)

Description:

Fine particle base material; light, medium, or dark grey base material (bentonite clay); may range in consistency from viscous semi-solid to thin and watery fluid; has white crystals that sparkle in sunlight on the surface of the material, around plants, or around the edges of the material as it dries. When dry, the grey clay is crumbly and is fairly easy to break apart.

Potential Hazards:

Brine drilling mud dumps can vary from viscous flowing piles of semi-solid material (dumped undiluted from frac tanks and other containers) to a watery grey fluid that dries to a thin grey coating on soil and rocks (dumped transport container wash out water). Caustics and other harmful chemicals are frequent additives to drilling muds. Salt in high concentration is toxic to soil microbes, insects, freshwater aquatic life, birds, wildlife, and livestock. O&G produced water and brine mud that has been circulated downhole can also contain cancer-causing man-made chemicals, hormone disruptors, and chemicals that target organs; a high odor of rotten eggs or hydrocarbons; and may contain H2S or other gases that can "gas off" as it dries. The "drier" the released material, the safer it is in terms of off-gassing potential and the greater the salt crystal formation. Salt crystals will remain on the surface until weather moisture (dew, rain, snow, or fog) pushes the salts further down into the material and subsoil. Highly corrosive to metal.

DUMPS ON THE GROUND

Brine based drilling mud (almost fully dry)

Description:

Light to dark grey fine particle base material (bentonite clay) with a large number of white to whitish crystals that sparkle in the sunlight on the surface and around the drying edges. When dry, the grey clay is crumbly and is fairly easy to break apart (as opposed to the harder dried material found in brine cement dumps):

Potential Hazards:

The salt crystals forming an uninterrupted crust across the surface of drying brine-based drilling mud demonstrates just how high the salt content is in the material. Salt in high concentration is toxic to soil microbes, insects, plants, freshwater aquatic life, wildlife, and livestock. Caustics and other harmful chemicals are frequent additives to drilling muds. O&G produced water and brine mud that has been circulated downhole may also contain naturally-occurring harmful materials, other man-made chemicals; and may contain H2S or other gases that can "gas off" as it dries. The "drier" the material, the safer it is in terms of off-gassing potential and the greater the salt crystal formation. Salt crystals will remain on the surface until weather moisture (dew, rain, snow, or fog) pushes the salts further into the material and subsoil. Highly corrosive to metal.

DUMPS ON THE GROUND

Freshwater drilling mud
(fluid state, at time of dump)

Description:

Light to dark grey fine particle base material (bentonite clay). A watery thin to viscous fluid.

Potential Hazards:

When freshly dumped (as pictured), it is visually impossible to distinguish freshwater drilling fluids from brine-based fluids. Both look virtually identical in a fluid state.

Some drilling and core hole boring activities require freshwater drilling mud rather than brine-based or diesel-based drilling muds. Even though freshwater drilling muds are not made up with brine water and diesel mediums, caustics and other harmful man-made chemicals are added to nearly all drilling muds. Although freshwater drilling mud lacks a high salt content, it may still contain cancer-causing man-made chemicals, hormone disruptors, and chemicals that target organs. Once a drilling mud release dries, is disturbed (as by traffic or cleanup operations), and becomes airborne, the bentonite clay in drilling muds can cause lung damage (silicosis) and is listed as a carcinogen. Bentonite clay dumps on the soil surface will also absorb subsequent weather moisture, stealing scant desert moisture from plant roots and causing vegetation die off from dehydration in the impacted area.

DUMPS ON THE GROUND

Freshwater drilling mud (fully dried)

Description:

Light to medium gray fine particle material (bentonite clay) that exhibits “clay cracks” in drying or fully dried material.

Potential Hazards:

This photo was taken two weeks after the photo of the freshwater drilling mud dump pictured in the previous photo. Drilling mud dumps may exhibit salt crystals around the edges (brine drilling mud) or not (freshwater drilling mud or weathered brine mud). Both however exhibit the classic “clay cracking” that occurs when hydrated clays dry out. With weather moisture, the clay will swell with the moisture and the cracks recede, but as the clay dries out afterwards the “clay cracks” will reappear. Consequently, “clay cracking” is a good visual identifier for bentonite clay based drilling muds, particularly in dried materials. Drilling muds contain a variety of chemical additives that can be cancer-causing, hormone disruptors, or harmful to animal and human health. Drilling muds can contain caustics that burn and irritate skin and membranes. Even without other additives, the bentonite clay in drilling muds can cause silicosis (lung damage) and is listed as a potential carcinogen when inhaled as a dust.

DUMPS ON THE GROUND

Drilling fluid rinsate dump
(tanker washout water with drilling fluids)

Description:

Fine particle material; light, medium, or dark grey base material (bentonite clay) that may range in consistency from a runny grayish fluid to a thin and watery fluid with a grayish cast (as pictured above); may or may not have white salt crystals on the surface or around the edges of the material as it dries.

Potential Hazards:

Transporters cannot haul freshwater or other materials in a "dirty" trailer or transport container. Many illegal dumps are created by transporters filling "dirty" containers and tankers with freshwater, then illegally dumping the contaminated wash out water (rinsate) on roadways or into pastures and arroyos. Contaminated washout water has the same hazards as undiluted contaminants, just to a lesser degree. However, washout water dumps are cumulative and with repetitive dumping eventually become the equivalent of dumping entire truck loads of undiluted contaminants. The predominant environmental hazard is the widespread release of contaminants into the surface environment. If freshwater was used as the wash water, the drying material may not exhibit the appearance of salt crystals around the edges as it dries, but salt contaminants may still be present (just not in the brine range of salts). Dried bentonite clay (grey material in the above photographed washout water dump) can cause lung damage (silicosis) and is listed as a potential carcinogen if inhaled. Consequently, bentonite clay dumps on roadways—whether undiluted or diluted with freshwater in washout water dumps—create health hazards as the material is disturbed by traffic and becomes airborne.

DUMPS ON THE GROUND

Brine range produced water with trace oil (dumped within 24 hours; gypsum soil)

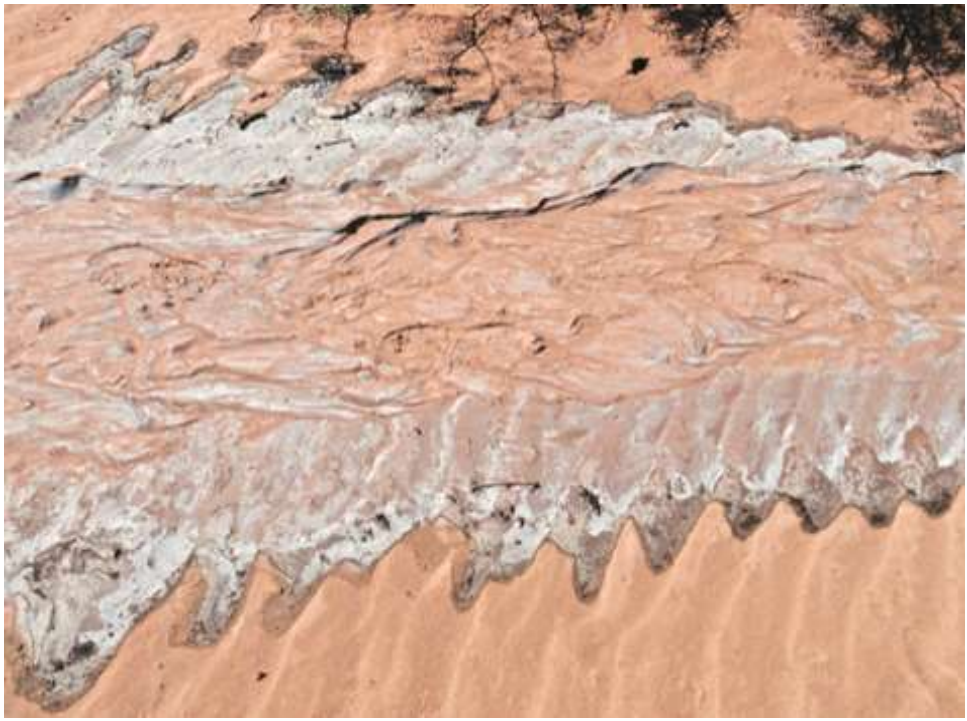
Description:

Pooled "clear" fluid (darkens the soil with hydration but has no discoloration) with "skim oil" and soil discoloration around edges. Note how the "hydrated" soil in the middle of the dump is lighter in color than the darker "skim oil" stained soil around the edges of the dump.

Potential Hazards:

The dump pictured above is a classic example of a brine range produced water dump with a small amount of trace oil that has been on the ground for less than a day. It has dried out enough to form marked visual salt crystals in a ring around the drying release with an exterior ring of trace oil around the outer edges that has "stained" the soil with a brownish oily stain. Salt in high concentration is toxic to soil microbes, insects, aquatic life, birds, wildlife, and livestock. Produced water and trace oil can also contain cancer-causing materials, hormone disruptors, and chemicals that target organs. May have a high odor. Can contain H2S, benzene, or other gases that can "gas off" as it dries. The older and "drier" the release, the safer it is in terms of off-gassing potential and the greater the salt crystal formation will be until weather moisture pushes the salts further into the subsoil. Oiled areas will remain "wet looking" far longer than the brine water component of the release and will "stain" the soil for an extended period of time. Highly corrosive to metal.

DUMPS ON THE GROUND



Brine range produced water with trace oil (still damp, not fully dry; sandy soil)

Description:

White crystals that sparkle in the sunlight on top of the soil with a trace of black oily discoloration around edges.

Potential Hazards:

Salt in high concentration is toxic to soil microbes, insects, freshwater aquatic life, birds, wildlife, and livestock. Produced water and trace oil can also contain cancer-causing materials, hormone disruptors, and chemicals that target organs. May have a high odor. Can contain H2S, benzene, or other gases that can "gas off" as it dries. The "drier" the produced water release becomes, the safer it is in terms of off-gassing potential and the greater the salt crystal formation until weather pushes the salts further into the soil. Oiled areas will remain "wet looking" far longer than the brine/produced water component of the release. Highly corrosive to metal. Salt in high concentration is toxic to soil microbes, insects, aquatic life, birds, wildlife, and livestock.

DUMPS ON THE GROUND

Brine range produced water with skim oil
(several hours old, salts just beginning to pop out on left side)

Description:

Pooled "clear" fluid (no discoloration) with black "skim" and rainbow sheen on the fluid surface and black oil and oil soil discoloration around edges (lower right).

Potential Hazards:

The dump pictured above is just several hours old. It has yet to dry out sufficiently to exhibit marked visual salt crystals. Even so, where trucks have driven through the release, some salt crystals are beginning to form (whitish area in truck tracks on left side of release), which is an indicator of a brine range produced water release. Salt in high concentration is toxic to soil microbes, insects, freshwater aquatic life, birds, wildlife, and livestock. Produced water and trace oil can also contain cancer-causing materials, hormone disruptors, and chemicals that target organs. May have a high odor. Can contain H2S, benzene, or other gases that can "gas off" as it dries. Oiled areas will remain "wet looking" far longer than the brine water component of the release and will "stain" the soil. Highly corrosive to metal.

DUMPS ON THE GROUND

Produced water and waste oil

Description:

Brine based drilling fluid with a high content of brownish-black skim oil; strong odor; dark discoloration of pavement from oil.

Potential Hazards:

This dump run extended for eight miles. All waste in the photo came from one tanker truck, dumping in broad daylight. Crude oil, waste oil, and tank bottoms contain cancer-causing materials, H2S (toxic gas), other gases (benzene, methane, etc.), and materials (both naturally occurring and man-made) that target organ systems. Hydrocarbons are toxic to water species and can contaminate water supplies. Salt in high concentration is toxic to soil microbes, insects, birds, wildlife, and livestock. Produced water can also contain cancer-causing chemicals, hormone disruptors, and chemicals that target organs. Both waste oil and produced water can off-gas various gases for some time. Gases can be explosive under the right conditions. Avoid generating sparks or creating other ignition sources. Stay upwind and uphill from release. Avoid touching material without barrier gloves or walking in material. If material gets on shoes or clothing, place contaminated materials in a sealed bag or drive with vehicle windows down to prevent being affected or overcome by off-gassed vapors in the confined space of your vehicle. Oily waste dumps on highways greatly increase the potential for accidents and fatalities.

DUMPS ON THE GROUND

Waste oil with condensates and brine range produced water

Description:

Light to medium brown or "rust" material that is much thinner in viscosity and lighter in color than typical crude oil or waste oil; may have a slight "greenish" hue to the base material; white crystals that sparkle in the sun indicate produced water; often characterized by a very strong "solvent" odor when condensates are present.

Potential Hazards:

Condensates are the "lighter" fraction of produced hydrocarbons and can contain high concentrations of benzene, toluene, and xylene (BETEX)—which gives a condensate a strong "solvent" odor and thins the viscosity of the released hydrocarbons. Waste oil and condensates can contain cancer-causing materials, H2S (toxic gas), other gases, and naturally occurring and man-made materials that target organ systems. Condensate range hydrocarbons are toxic to water species, travel rapidly through soil layers, and can contaminate water supplies. Salt in high concentration is toxic to soil microbes, insects, birds, wildlife, and livestock and can also harmful components. Condensate waste oil and produced water can off-gas various gases for some time. Oil is flammable and gases can be toxic (H2S) and explosive under the right conditions. Avoid generating sparks or creating other ignition sources. Stay upwind and uphill from release. If material gets on shoes or clothing, place contaminated materials in a sealed bag in the truck bed or drive with vehicle windows down to prevent being affected or overcome by off-gassed vapors in the confined space of your vehicle. The hotter the temperature, the more off-gassing will occur.

DUMPS ON THE GROUND

Waste oil and brine range produced water

Description:

Dark Brown or Black thick viscous fluid with white crystals that sparkle in the sun surrounding it. In the photo above, the "white salt crystals" are "wicking up" the vegetation in the dump site.

Potential Hazards:

Crude oil, waste oil, and tank bottoms contain cancer-causing materials, H2S (toxic gas), other gases (benzene, methane, etc.), and materials (both naturally occurring and man-made) that target organ systems. Hydrocarbons are toxic to water species and can contaminate water supplies. Salt in high concentration is toxic to soil microbes, insects, birds, wildlife, and livestock. Produced water can also contain cancer-causing chemicals, hormone disruptors, and chemicals that target organs. Both waste oil and produced water can off-gas H2S and other gases for some time. Oil is flammable and gases can be highly toxic (H2S) or explosive under the right conditions. Avoid generating sparks or creating other ignition sources. Stay upwind and uphill from release. Do not touch without barrier gloves and avoid walking in material. If material gets on shoes or clothing, place contaminated materials in a sealed bag and place the bag in the truck bed or drive with vehicle windows down to prevent being affected or overcome by off-gassed vapors in the confined space of the vehicle. The hotter the ambient temperature, the more off gassing that can occur from contaminated materials.

DUMPS ON THE GROUND

Crude oil with very low produced water content (waste oil and tank bottoms look very similar)

Description:

Brown, dark brown, or black thick and viscous fluid; lacks visible salt crystals around the edges. While both waste oil and tank bottoms look very similar, the produced water content will be higher.

Potential Hazards:

Crude oil is a valuable product and is closely tracked by operators. Crude oil dumps do occur, but primarily by accident—with the driver abandoning the released material, which makes it an illegal dump. Waste oil and tank bottom dumps occur much more frequently—and often on purpose. Crude oil, waste oil, and tank bottoms contain cancer-causing chemicals, H2S (toxic gas), other entrained gases (benzene, methane, pentane), and chemicals that target organ systems. Crude oil can be toxic to animals, particularly birds and bats. Birds and small mammal can "drown" in crude oil dumps. Hydrocarbons are toxic to water species and can contaminate water supplies. Crude and waste oil can off-gas various gases for some time. Gases can be highly toxic (H2S) and explosive under the right conditions. Avoid generating sparks or creating other ignition sources. Stay upwind and uphill from release. Avoid touching without barrier gloves or walking in material. If material gets on shoes or clothing, place contaminated materials in a sealed bag in the truck bed or drive with vehicle windows down to prevent being affected or overcome by off-gassed vapors in the confined space of your vehicle. The hotter the temperature, the more off gassing will occur.

DUMPS ON THE GROUND

Frac sand

Description:

Granular solid material that "looks like sand"; may be colored to closely mimic/ resemble the appearance of naturally occurring sand or may be a variety of colors (including colors not pictured).

Potential Hazards:

The top photo shows a samples of dumped frac sands, all of which are coated frac sands except one—the sample that is pictured third from left. Since coatings on frac sand coat the sharp edges of the sand particles, coated frac sand has a "more rounded" appearance than uncoated sand. Coated frac sand can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Some frac sands may contain Teflon® or radioactive tracers. Some frac sand coatings are water soluble, can be transported in rain events, and can contaminate water supplies. While uncoated frac sand is less hazardous, and is "just sand" without chemical additives, inhalation of sand silica particles can damage the lungs (silicosis). Do not touch or handle without barrier gloves. Avoid walking in material or breathing dusts. Frac sands should be picked up and properly disposed of as solid chemical waste.

The coatings on some types of coated frac sands can fuse together to create artificial "frac rocks" (photo at right).

DUMPS ON THE GROUND

Frac Acid, Hydrochloric Acid, or Other Acid

Description:

White crusting on soil that lacks crystals and does not "sparkle" in the sunlight; soil crust may have a "bubbly" or "foamy" appearance even when dried; may have a "pie crust" effect on soil surface, creating a slightly raised crust; white crusting may sit directly on the soil surface or be atop another base material.

Potential Hazards:

Acid is used in large bulk quantities in some fracking operations, which makes frac flowback fluids (large volume fluid wastes) highly acidic. Frac flowback dumps are common. Acid is lethal in high concentrations to soil microbes and insects. When fresh, it can cause severe burns and lung damage to animals and humans. May have a strong "vinegary" or "acetic" smell when fluid or semi-fluid. If you can smell acid odor, you are too close to the release; remove yourself upwind. Even after acid is neutralized, it changes soil pH and prohibits growth of native vegetation. As acids are neutralized by contact with alkaline soil, the chemical reaction creates a white foaming substance that crusts and hardens as it dries. The white crusts formed by acid chemical reactions tend to be longer lasting than the salt crystals on the surface of produced water dumps and will not weather or recede into the soil as readily with weather moisture. Some frac acids can "burn through" barrier gloves, penetrating the glove and burning skin underneath. Avoid handling acids or acid contaminated materials. As acids are neutralized by contact with alkaline soil, the odor and acid hazards are decreased but caution is still advised.

DUMPS ON THE GROUND

Frac “slick gel”, dried

Description:

Clear released fluid material that looks “wet” even when dry; released material may exhibit a very slight and “transparent” gray cast.

Potential Hazards:

Frac “slick gels”, “slick water”, and high viscosity gels may be made from naturally occurring guar gum, engineered man-made polymers, or both, and combined with other man-made chemical additives. Like other frac fluid additives, there are few short- or long-term studies of environmental impacts because frac fluids are intended for use downhole, not for release into surface environments. Illegal dumping short circuits that intended use and disperses frac fluids widely into surface environments, which can lead in turn to contamination of surface water and groundwater. The short- and long-term environmental and health impacts of frac fluid additives is largely unknown, and little is known about the release or fate of man-made polymers into the environment. Frac fluids can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Can contaminate water supplies. Frac “slick gels” dumped on paved roadways can rehydrate in rain events, make the roadway extremely “slick” (more so than oil), and create severe public safety hazards, including loss of vehicle control and fatalities. Dumped gel materials may be combined with other fracking materials and production fluids. May contain entrained well gases, like H2S. Some frac fluids contain acid that can burn skin and damage lung tissues.

DUMPS ON THE GROUND

Frac fluids, dried

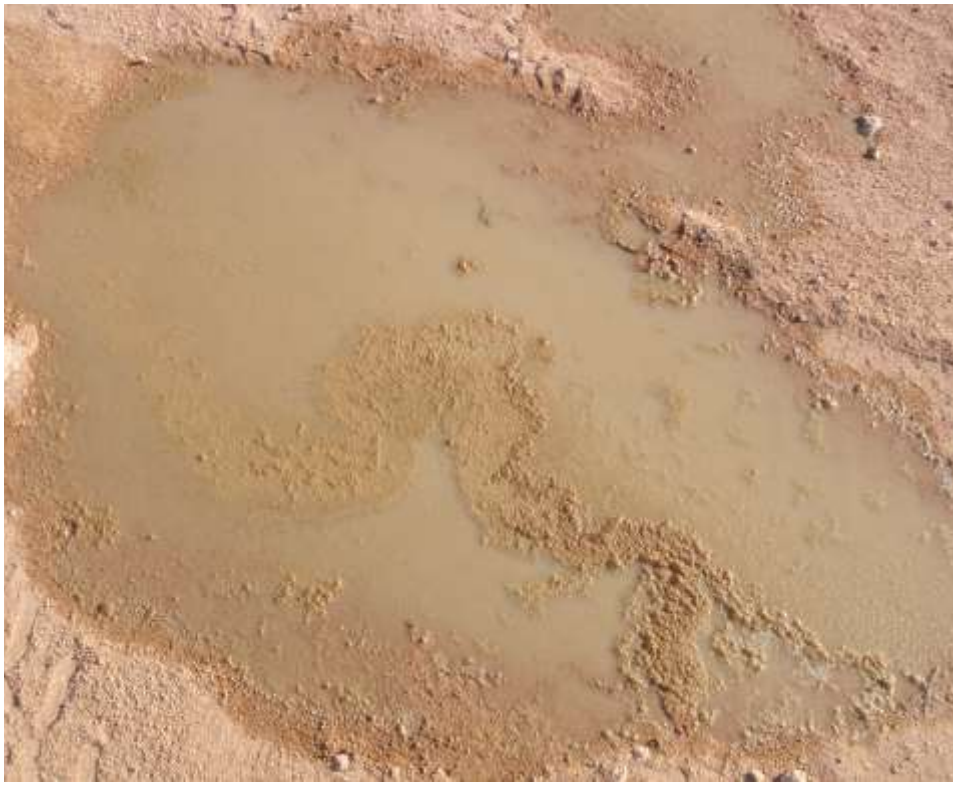
Description:

Semi-fluid or fluid materials that may be a variety of colors, clear, or white; surface resembles "melted plastic" (caused by high polymer content in the fluid); high acid content may create white crusting around the edges.

Potential Hazards:

The above photo of a "repeated use" dumpsite is not characteristic of a "typical" frac fluid dump, but it is an excellent example of three undiluted primary components of frac fluids side-by-side in a dried state. On this location, frac gel was dumped first (the clear material with a slight grayish cast at the bottom center of the photo) from frac tanks on this location. Then, frac acid was dumped from frac tanks, forming the white "bubbly" crust of acid chemical reaction with alkaline soils across the center of the photo. Finally, frac fluids containing polymers were dumped from frac tanks, which created the "plasticized" and yellowish discolored material at the top of the photo. While the flow patterns of each of these materials is clearly distinct in this photograph, these materials are usually blended together and dumped as a combined composite material in the majority of frac fluid dumps. Frac fluids can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Can contaminate water supplies. The fate of frac polymers in the environment and associated health hazards are currently understudied and largely unknown. Some frac fluids contain acid that can "burn through" barrier gloves even when "semi dry".

DUMPS ON THE GROUND



Frac Fluids, recently released (still "pooled" and "wet")

Description:

Watery to slightly viscous material that may be a variety of colors; base materials and fluid may be yellowish, greenish, pinkish, brownish, other colors, clear, or "milky" white; particulates in the fluid may have a "flocculated" or "clumping" appearance similar to soured milk.

Potential Hazards:

Frac fluids contain frac gel, frac chemicals, polymers, and possibly man-made radioactive tracer materials. Frac fluids can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Frac fluids often have a high acid content. Frac fluids can contaminate water supplies and some frac chemicals are environmentally persistent. The fate of frac polymers in the environment and associated health hazards are currently understudied and largely unknown. Some frac fluids contain acid that can "burn through" barrier gloves (permeate the glove barrier and burn skin underneath). May contain entrained well gases, like H2S, or other chemicals that can off gas vapors. Avoid touching or walking in material; stay upwind and uphill from release.

DUMPS ON THE GROUND

Frac fluids, dried
(2 weeks on the ground)

Description:

Semi-fluid or dried material that may be a variety of colors, clear, or white; surface resembles “melted plastic” (caused by high polymer content in the fluid).

Potential Hazards:

Frac fluids contain frac gel, frac chemicals, polymers, and possibly man-made radioactive tracer materials. Frac fluids can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Can contaminate water supplies. The fate of frac polymers in the environment and associated health hazards are currently understudied and largely unknown. Some frac fluids contain acid that can “burn through” barrier gloves even when “semi dry”.

DUMPS ON THE GROUND

Frac fluids, dried; older dump with polymer degradation

Description:

Dried material with a fibrous "paper maché" appearance (like wet newspaper but dry, light, fluffy); may be whitish, grayish, or have a color cast; dried material tends to "peel" back from the soil surface in larger "sheets" or in spots with wind, animal tracks, or other disturbance. Thickness of "sheets" depends on depth of original release on surface and amount of polymer in the original release. May be ¼" to over 1" thick (see also: "sewage dump", which has similar "sheet" and "peeling" qualities).

Potential Hazards:

As released frac fluids dry out, the released polymers undergo radical transformation over time. Completely dried and degraded frac fluid dumps have little resemblance to fresh or recently dried frac fluid dumps. As the frac polymers begin to weather and degrade with time, the material "fluffs up" in fibrous masses that resemble newspaper fibers, and then becomes friable and readily airborne. Frac fluids contain frac gel, frac chemicals, polymers, and possibly man-made radioactive tracer materials. Frac fluids can contain cancer-causing chemicals, hormone disruptors, and chemicals that target organ systems. Can contaminate water supplies. Drying frac fluid dumps generate "sheets" of light, fluffy, and easily airborne particulate matter with largely unknown consequences to people or animals that inhale it. Some frac fluid dumps can resemble fibrous material in sewage waste dumps, especially if the frac fluid dump was generated by frac fluid container wash out water and released as a more diluted (thin and watery) contaminant into the environment. Stay upwind and avoid breathing particulates.

DUMPS ON THE GROUND

Bulk sewage dump, dried

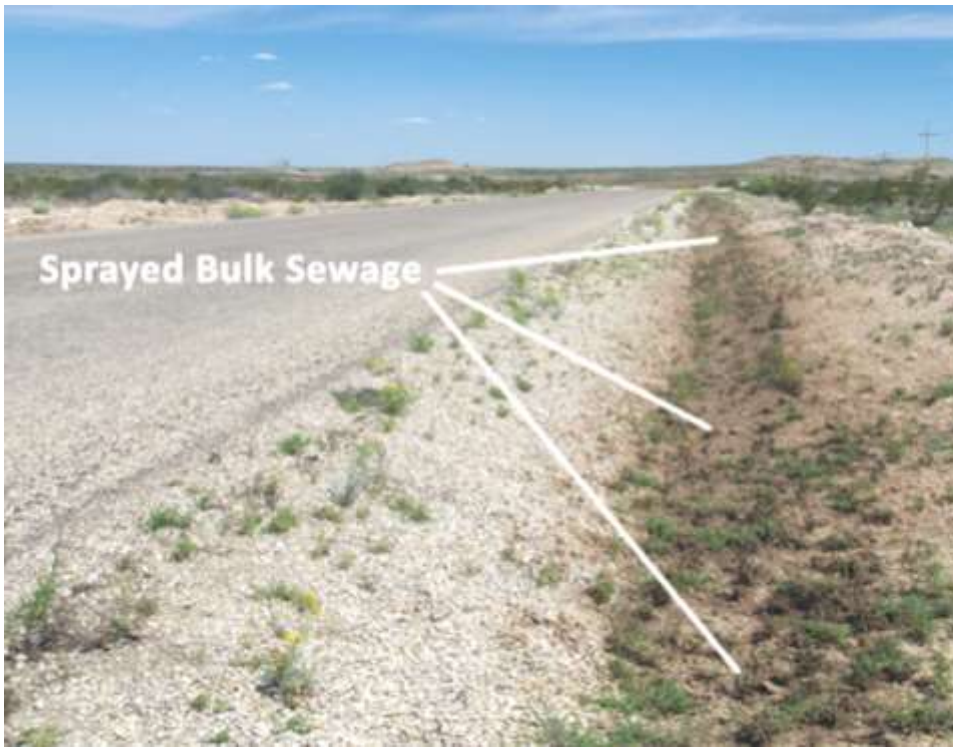
Description:

Sewage dumps when wet may be grey, brown, or slightly greenish/blue cast material with a paper fiber slurry content; may contain other "trash" such as straws, plastic cutlery, syringes, etc.. As the material dries, it will exhibit a tendency to pull away from the soil surface in thin (typically ¼" or less) "sheets" with wind, animal tracks, or other disturbance. (see also "Frac Fluids, dried", which has similar visual "sheeting" and "peeling" qualities).

Potential Hazards:

Can contain a host of chemicals and *E. coli* bacteria. May contain pharmaceuticals, drugs, syringes, or anything else that can be flushed down a toilet or dumped in the sewage tank to prevent disposing of the material properly. Sewage treatment chemicals may include ammonia, bleach, formaldehyde, and sanitizers that can sterilize soil microbes, be harmful to insects and animals, contaminate water, and impact human health. Fluid sewage material will off-gas chemical vapors as it dries. The drier the material, the less off-gassing will occur. Avoid breathing vapors or particulates; stay upwind; do not touch without barrier gloves; avoid walking in material; and wash hands thoroughly before eating or drinking.

DUMPS ON THE GROUND



Sewage dump, recent (still "wet" in the center with dried edges)

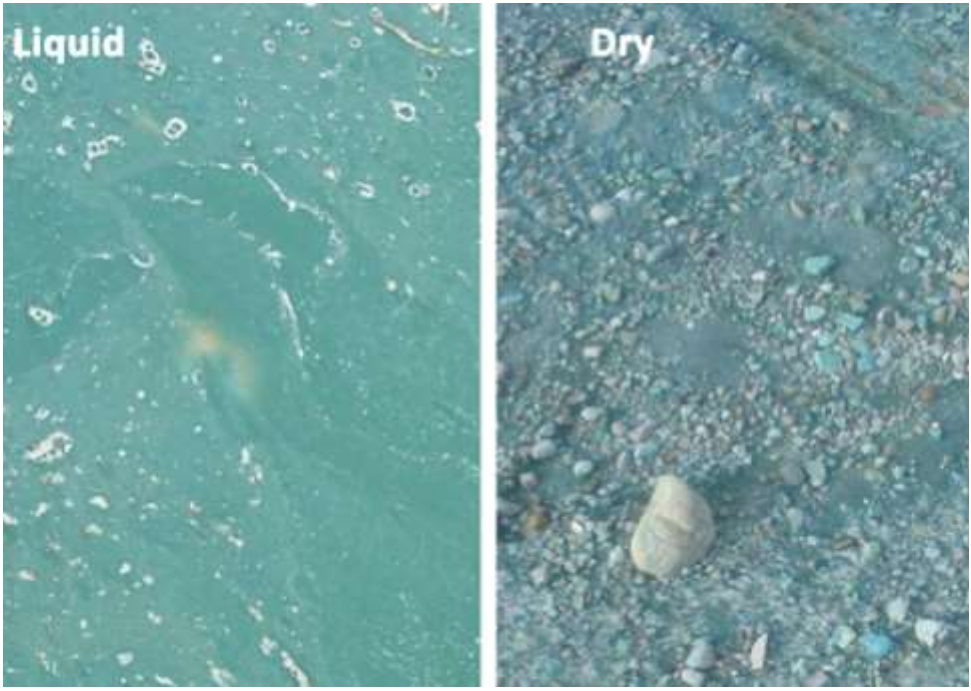
Description:

Grey slurry material with high water content. May be lightly greenish/blue to grayish cast material with a paper fiber slurry; may contain other "trash" such as straws, plastic cutlery, syringes, etc.. As the material dries, it will exhibit a tendency to pull away from the soil surface in thin (typically ¼" or less) "sheets" with wind, animal tracks, etc. (see also "Frac Fluids, dried", which has similar visual "sheeting" and "peeling" qualities)

Potential Hazards:

Bulk sewage must be disposed of at city sewage treatment plants. The above photo documents a seven mile dump from a bulk tanker truck with a side spray attachment. In several weeks time, both sides of the highway ditches were sprayed repeatedly—in a high cave/karst area and through a low water intermittent stream crossing. Bulk sewage dumps (both sprayed during transport and stationary "parked" dumps with large pools) were first documented in 2018 and have increased ever since. Bulk sewage dumps can contain *E. coli* bacteria and other biological contaminants (bacteria and viruses). May contain pharmaceuticals, drugs, syringes, waste chemicals, or anything else that can be flushed down a toilet or dumped in the bulk sewage tank to prevent disposing of the material properly. Bulk sewage may or may not be partially treated. Sewage treatment chemicals may include ammonia, bleach, formaldehyde, and sanitizers that can sterilize soil microbes, be harmful to insects and animals, contaminate water, and impact human health. Fluid sewage material will off-gas chemical vapors as it dries. Avoid breathing vapors or particulates; do not touch without barrier gloves; avoid walking in material; and wash hands thoroughly before eating or drinking.

DUMPS ON THE GROUND



liquid portable toilet dump (left); dried portable toilet dump (right)

Description:

Wet (left image): Blue green fluid: may also contain solid and semisolid toilet material/ waste; strong chemical and sewage odor. Dried (right image): Blue green with crystals; may also contain solid and semisolid toilet material/waste; odor diminishes with drying.

Potential Hazards:

Can contain a host of chemicals and *E. coli* bacteria. Portable toilet chemicals may include ammonia, bleach, formaldehyde, and sanitizers that can sterilize soil microbes, be harmful to insects and animals, contaminate water, and impact human health. Material will off-gas chemical vapors as it dries. Avoid breathing vapors or particulates; avoid walking in material; use barrier gloves; wash hands thoroughly before eating or drinking. Dried material may have little odor, but still contains materials that are harmful to the environment.

DUMPS ON THE GROUND

Herbicide or pesticide dump

Description:

Blue to blue green fluid without solids or fibrous particulates; separation may be evident between colorant and other fluids in the release. (see also: "liquid portable toilet dump", which has similar visual qualities).

Potential Hazards:

Lawn care, weed control, and pest control providers often add a blue colorant to applied chemicals to distinguish treated from untreated areas. The above photo shows repeated illegal dumps of dyed herbicide/pesticide chemicals on a roadway. While the coloration of dyed agricultural materials may be very similar to portable toilet fluids (see prior page), dyed agricultural chemicals will sometimes exhibit dye separation from the carrier chemicals/medium in the edges of releases on soil as shown above, indicating that the added dye mixed with some, but not all, of the chemical components. The pictured dump (above) extends for several miles in both directions, indicating the material was released during transport from an open valve. Dyes are used with a variety of applied agricultural chemicals, so dye color does not indicate what was dumped. Both pesticides and herbicides contain chemicals that can pose short and long-term health hazards, are detrimental to the environment, can contaminate waterways and drinking water, and that can be detrimental to plants, livestock, wildlife, and public health Avoid breathing vapors or particulates; do not touch without barrier gloves; avoid walking in material; and wash hands thoroughly before eating or drinking.

DUMPS ON THE GROUND

Antifreeze; glycol; ethylene glycol; diethylene glycol; propylene glycol; methanol

Description:

Brightly colored transparent to translucent fluids in any of the following colors:

Potential Hazards:

Ethylene glycol and diethylene glycol are primary components in vehicle antifreeze/ coolants and are colorless, practically odorless, hygroscopic liquids (absorbs moisture from the air) with a sweetish taste. As a result, these chemicals are highly attractive to bees, pollinators, wildlife, livestock, and small humans; and are also highly and rapidly toxic when ingested, typically ending in fatality. Can contaminate water supplies. Various dyes are added to vehicle antifreeze products to distinguish antifreeze type, which allows us to determine that this dump was antifreeze from a vehicle or other large equipment. Bulk quantities of undyed, colorless gylcols are also used in oilfield operations; are equally toxic to livestock and wildlife; and are harder to visually identify when released or dumped than dyed coolants. Avoid touching material without barrier gloves, walking in material, or getting on shoes or clothing.

DUMPS ON THE GROUND

Used transmission fluid

Description:

Translucent to opaque fluid in the following colors:

Potential Hazards:

Transmission fluid, typically transparent and bright red or amber in color when "fresh", changes color and opacity as it wears and ages. It may also pick up very fine to larger heavy metal particulates and/or other chemical contaminants depending on the purpose of the equipment of origin. Transmission fluids may contain glycol-ether, mineral oil, petroleum distillates, or other forms of light oil hydrocarbons. When clean, transmission fluid poses minimal health hazards, but health hazards increase for used transmission fluids (which is what is typically found in a dump site). All oils, clean or not, are toxic to aquatic life and can contaminate drinking water and surface water. Used transmission fluid dumps may have semi-transparent fluids on the surface and heavier darker color material with particulates underneath. The pictured transmission fluid dump had reddish clear fluid on the top of the release and dark grey fluid material with particulates underneath.

DUMPS ON THE GROUND

Used hydraulic fluid combined with used diesel oil

Description:

Hydraulic fluids are transparent to opaque fluids with the following colors:

Potential Hazards:

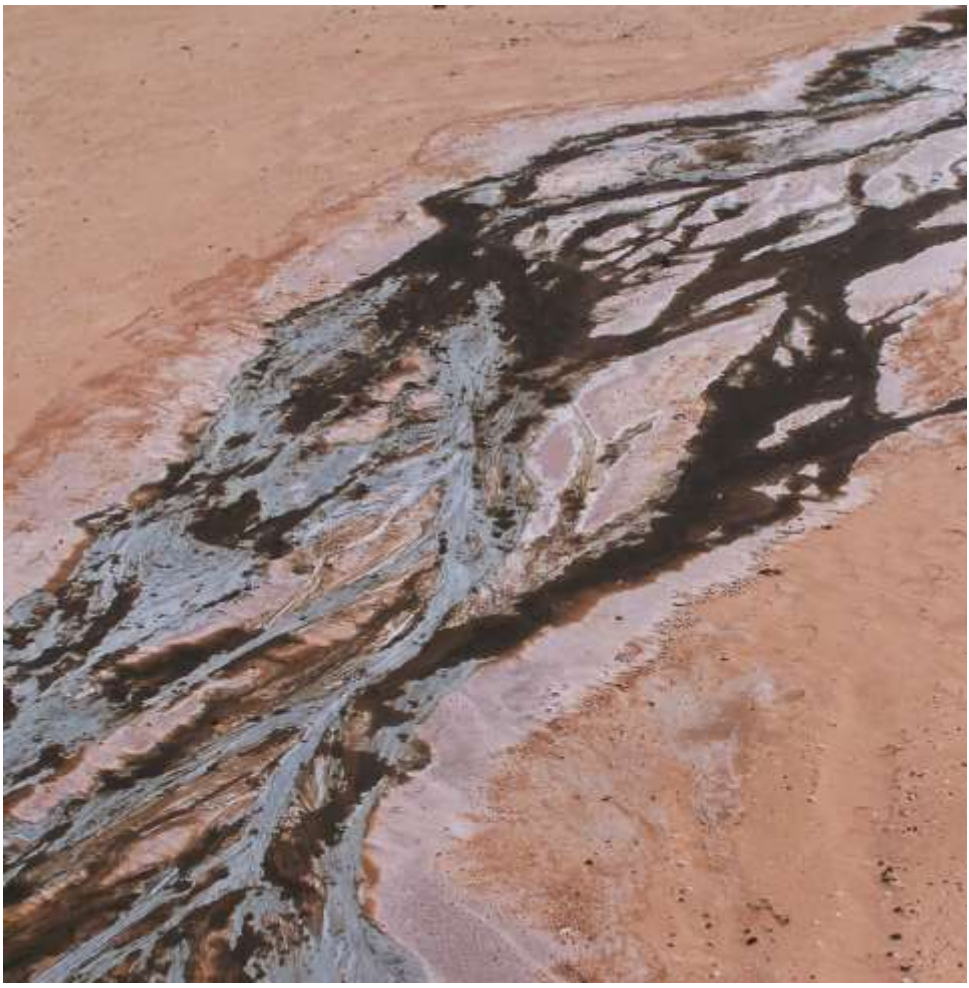
This photo is of an illegal dump of combined used heavy equipment vehicle fluids on the bank of the Pecos River. When different vehicle fluids are mixed together in one dump (as in this one), the color and visual characteristics of the combined fluids are changed. In this case, we have a good indicator of what was dumped from labeled and empty containers left at the dump site. The visual clue that this is a vehicle fluid dump is the presence of a highly refined and thin oil around the edges of the dump, which is not characteristic of crude oil or waste oil. Hydraulic fluids typically have a mineral oil base and can contain many other chemical additives. Hydraulic fluids can contaminate soil, groundwater and surface water, and can harm humans, animals, and marine life due to their toxicity and chemical composition. Hydraulic fluids do not break down easily in the environment and can be persistent. Used oils may contain heavy metals and other harmful impurities that present risks to health and the environment; skin contact should be avoided; may cause skin cancer.

DUMPS ON THE GROUND

Mixed waste dump: produced water, waste oil, unknown material

The above photo documents a "mixed waste" dump site that is not "typical" of most O&G waste dumps. No matter how much experience you have with visual assessment, there is always the potential that you will encounter something you have never seen before. This release has the clear fluid that typically indicates some sort of water-based medium. It has some salt crystals popping out around the edges (very bottom of photo) that indicates the presence of high saline produced water. An "oil sheen" appears on the surface of the fluid and dark brown oily skim is present around the edges—both of which indicate waste oil. However, the whitish foamy material in the center of the photo is "not typical" of most produced water and waste oil dumps. Since it appears that the "oil" component of the release is "repelled" by the white foam, a good guess might be that the foam is some sort of surfactant. The foam may be a relatively benign industrial soap or it may be an extremely hazardous material. Without lab analysis, the exact identity of released materials cannot be ascertained. Consequently, this release should be reported as a "release that *looks like* produced water with trace or waste oil as well as an unknown foaming material" and treated as hazardous waste until proven otherwise.

DUMPS ON THE GROUND



Mixed waste dump: produced water, waste oil, unknown material

The above photo, which was featured on the cover, documents an illegal dump of mixed materials. In many respects, this dump contains the classic visual characteristics of produced water with skim oil. It has the white crystals of produced water around the drying edges of the dump and a dark oily material that looks like crude oil. However, there is a grey material present in the release flow that is separate from the water, as well as separate from the oil. This is an unusual characteristic. Even though the gray material closely resembles drilling mud—it's not drilling mud because of the way it is "behaving" in the released material. Best guess is that the grey material is some sort of polymer or other chemical additive. But that's a guess and the environmental and health hazards of this dump are unknown. Consequently, this release is reported as "a release that looks like produced water with trace oil and an unknown gray fluid" and treated as hazardous waste until proven otherwise.

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