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FARM FUEL STORAGE & HANDLING

1. Why is Farm Fuel Storage and Handling Such an Important Issue?

The capacity of diesel and gasoline storage on Alberta farms is at least 250 million litres (55 million gallons). This large volume of stored fuel poses great financial, environmental and public liability risks to farmers. This publication provides information to help farmers store and use gasoline and diesel fuel.

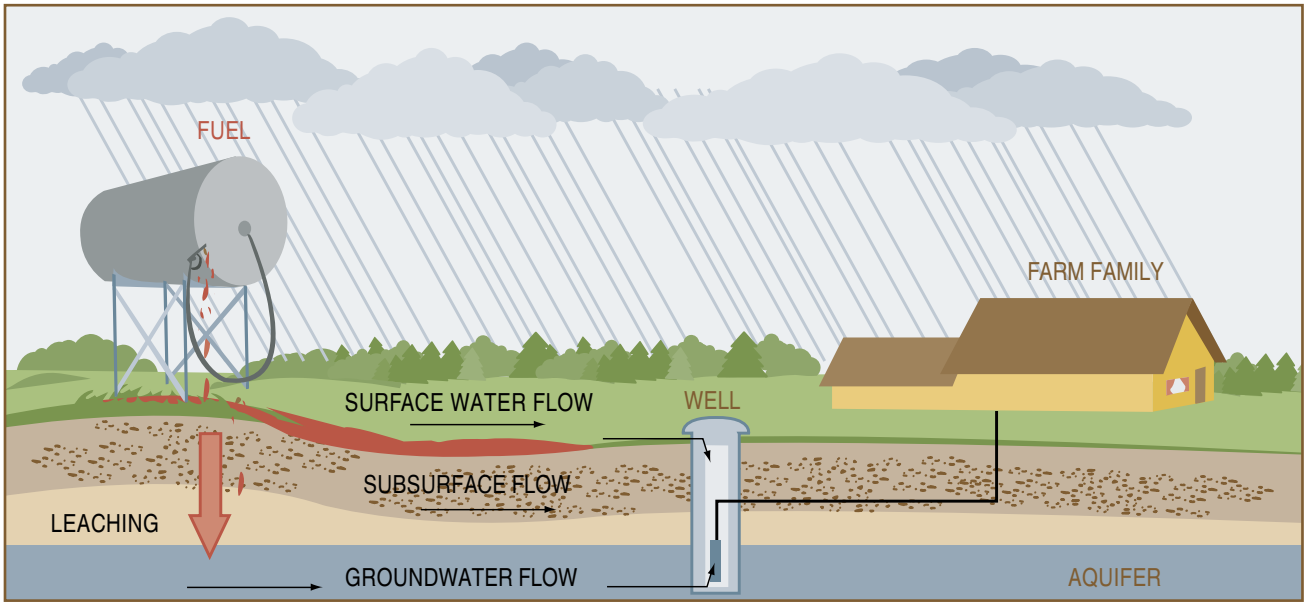


Figure 1: Fuel storage as a possible source of contamination

Traditionally, fuel storage on farms in Alberta consisted of overhead, gravity fed tanks (as shown above in Figure 1). Although these types of systems are still very common on today's farms, there are now other options available to producers in Alberta. The traditional gravity type systems are being replaced with systems that reduce the risk of fire, spills and leaks, and help to avoid contamination, evaporation, deterioration and theft.

Environmental implications

It is the responsibility of all Albertans to ensure the protection, enhancement and wise use of the environment. No person is allowed or permitted to release a substance in an amount, concentration level or at a rate that causes or may cause a significant adverse effect. Poor management of fuel storage tanks can lead to environmental impacts on soil and groundwater and health and safety issues. It only takes a few litres of gasoline to severely pollute a farmstead's drinking water supply. A small leak of one drop per second can release about 900 litres (200 gallons) of gasoline into the groundwater in one year.

Financial implications

Practicing "due diligence" is also a major part of protecting the ability to borrow money or obtain insurance. Banks, lending agencies and insurance companies recognize the risks of farm fuel storage and handling. Potential risks of environmental damage may be enough to prevent loan approval or insurance coverage.

2. What Can We Do?

For producers that are looking for options for their existing on-farm fuel storage, there is basically two of alternatives: replacement or improvement.

There are many options and variations in the design of a petroleum storage site. Figure 2 illustrates one example of a well-planned site, using single walled tanks with a secondary containment built into the foundation. Alternatively, you could use double walled tanks, avoiding the need for the additional containment in the foundation.

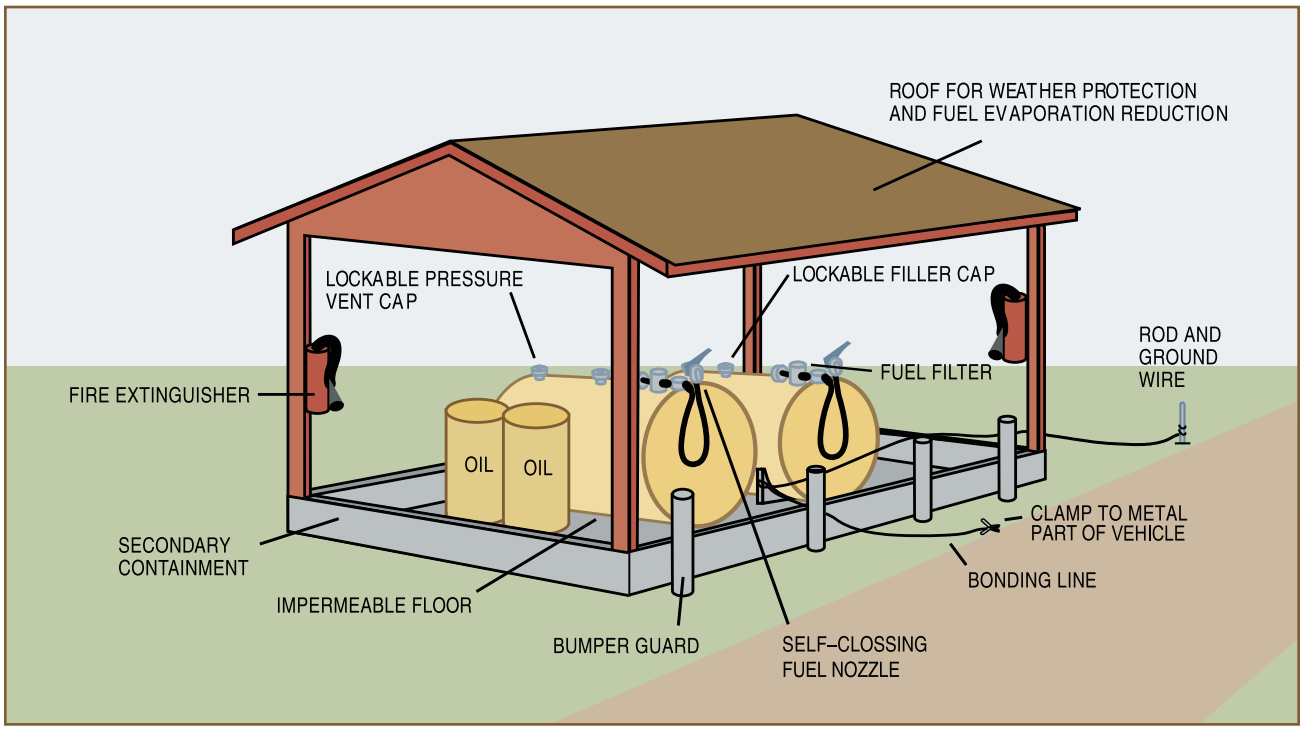


Figure 2: Well-planned petroleum storage site
Adapted from Resource Management Branch, BC Ministry of Agriculture and Lands

Characteristics of this well-designed system include:

- Proper foundation (impermeable floor)
- Secondary containment
- Proper venting (pressure vent cap separate from fill opening)
- Emergency plan and equipment (fire extinguishers)
- Collision protection (bumper guards)
- Theft / vandalism protection (lockable caps)
- Prevention of evaporative losses (shade)
- Grounding for prevention of static electricity (bonding line and ground wire)
- Monitoring for losses due to theft or evaporation (fuel meter)

This publication illustrates in greater detail the characteristics described above. See section 7, *Planning a Fuel Storage Site* for more information.

3. What is the Legislation Regarding Farm Fuel Storage?

In Alberta, there are three pieces of legislation that farmers should consider with regards to storing and handling fuel on the farm:

- *Alberta Fire Code (AFC)*
  - The major legislation governing the storage of flammable and combustible products
  - Fuel storage used solely for agricultural purposes is exempt from the code
  - Fuel storage used for other commercial activities, such as operating a school bus or grader, are not exempt

- *Transportation of Dangerous Goods (TDG) Regulation*
  - Enforced on all Alberta highways and roads
  - Dangerous goods are regulated from the time of loading to delivery
  - Farmers are not exempt from the overall regulation, but there are some exemptions for them in transporting gasoline and diesel

- *Environmental Protection and Enhancement Act (EPEA)*
  - Supports and promotes the protection, enhancement and wise use of the environment
  - Allows for large penalties for polluters, including cleanup costs and possible imprisonment[1]

Although the storage of fuel on farms intended for individual farm use is exempt from the AFC, farmers are not exempt from the EPEA. Prosecution under the EPEA may be avoided if "due diligence" can be shown[2]. While this minimizes the chance of mishap, it doesn't diminish the responsibilities of storing and handling fuel. The AFC provides a guideline that farmers can use to help prove due diligence. For this reason, many of the recommendations in this publication are taken from the AFC.

[1] EPEA, Sec. 228
[2] EPEA, Sec. 229

4. What are the Risks?

Storing and handling fuel on the farm can pose many risks to personal safety, property damage, and environmental contamination. A few risks addressed in this publication include health effects, fire, and leaks and spills.

Health effects

Exposure to diesel or gasoline can occur through breathing vapours, swallowing fuel or skin contact.

Possible health effects include:

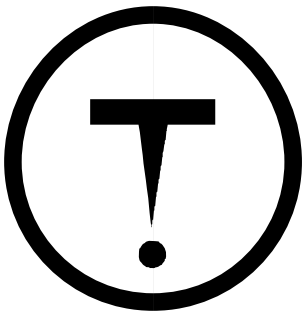
- Skin irritation, dermatitis
- Chemical burns due to prolonged contact
- Eye and respiratory passage irritation
- Headaches, dizziness, nausea, and central nervous system depression
- Possible cause of cancer

Preventative measures include:

- Perform all fuel transfers outdoors to prevent fumes from building up and creating a dangerous explosive environment
- Vent exhaust outside when operating motors inside a building
- Avoid breathing fuel or exhaust fumes
- Wear neoprene gloves, not leather or cloth, when transferring fuel
- Thoroughly wash hands, clothing, etc. after exposure or contact with fuel
- Ensure all tanks, etc are properly labeled so that users are aware of the potential hazards associated with the product (see WHMIS below)

The Workplace Hazardous Material Information System (WHMIS) is a comprehensive plan for providing information on the safe use of hazardous materials. Labels will inform anyone drawing fuel from the tank to take the appropriate precautions. As well, Material Safety Data Sheets (MSDS) are documents that contain information on the potential hazards and how to work safely with the chemical product. MSDS for gasoline and diesel can be obtained from the supplier.

Class B2 – Flammable (gasoline)
Class B3 – Combustible (diesel)



Class D2A – Carcinogenicity (gasoline)
Class D2B – Other Toxic Effects – Skin Irritant (diesel)

Figure 3: WHMIS symbols for diesel fuel and gasoline

Fire

As dangerous and destructive as fuel is in a liquid state, it's even more dangerous as a vapour. The lower explosive limit (LEL) of gasoline is 1.4% so, under certain conditions, vapours may explode spreading fire over a large area.

Possible sources of ignition may include:

- Electric motors
- Yard lights
- Power lines
- Electric fences
- Air conditioning or heating units
- Garbage burning barrels
- Vehicles (i.e. overflow of fuel onto hot exhaust, engine, etc.)
- Smoking
- Glass debris (can refract sunlight and ignite dry grass)
- Electrical appliances
- Ignitions for gas appliances (heaters, furnaces, etc.)
- Cell phones
- Static electricity (produced by the movement of vehicles, machinery, grain through augers, etc.)

An emergency switch to shut off power to all dispensers and pumps should be provided at a location away from the storage tanks and shielded from any fire that may occur in the dispensing-area. Ensure that this switch is part of your emergency plan and that all residents and employees know of its location.

Preventative measures include:

- Ensure wiring of pumps, meters, etc. are installed and maintained in a manner suitable for Class I hazardous locations[3].
- Clean up minor spills and keep the area free of tall vegetation and debris
- Ground all above ground tanks - a spark from static electricity could ignite the fuel (see section 7, *Planning a Fuel Storage Site*)
- Position tanks safely and at least 3 metres from all buildings
- Ensure tank vents discharge vapour away from sources of ignition (i.e. electric motors, yard lights, power lines, electric fences, etc.)
- Keep fuel lines, hoses, valves and nozzles in good repair
- Do not smoke while handling fuels
- Turn off vehicles while refueling
- Install at least one fire extinguisher (Type purple K of at least 20 pounds) close to your fuel tanks (2 extinguishers located at opposite corners of the site would be ideal)
- Contact your local fire department about receiving training on handling petroleum fires

[3] Contact a qualified electrician or refer to The Electrical Code

Leaks & spills

Risk of lost product due to leakage varies with the type of storage involved. Cleanup costs can be high, especially if the leaked fuel contaminates surface or groundwater. In addition, there is always the risk of leaked fuel igniting. The greatest risk of loss affecting on-ground and underground tanks is that of an undetected leak in the concealed portion of the system. In that case, there is usually an ongoing loss of fuel and once the loss is detected, repair and cleanup costs can be very high.

Small spills may not seem to be a great concern but if they continue at the same location over a prolonged time period, there is a potential for an adverse effect to the groundwater.
The contamination of groundwater is an extremely serious problem. There is no practical way to clean up groundwater contamination. According to Canadian drinking water standards, one litre of gasoline can make 1 million litres of drinking water unfit for human consumption.

Vapours from leaked fuel may enter buildings through septic lines, utility lines, cracked foundations or other means with potentially explosive results. Even if explosive levels are not reached, there is still the health risk of prolonged exposure to fuel vapours.

If a spill does occur, use a non-combustible material (i.e. earth, clay) to block the spill from running into water bodies or buildings and absorb the liquid. Do not use rags or sawdust to clean up the spill as these materials can easily catch fire.

Possible causes of spills or leaks include:

- Collision with vehicles, machinery or other moving equipment
- Operator negligence when filling equipment or storage tanks
- Expansion and overflow of fuel in tanks that are filled more than 90 per cent of their capacity (due to heating from sun)
- Corroded or improperly sealed hoses, fittings, pumps or tanks
- Vandalism

Preventative measures may include:

- Proper siting and installation of storage tanks
- Barriers (e.g. bollards) to protect from collisions
- Automatic shut off nozzles
- Do not leave refueling procedures unattended
- Support small containers so that they don't tip over during filling
- Keep all nozzles, fittings, hoses in good repair
- Ensure storage tanks are easily accessible for fuel delivery operators
- Regular monitoring of storage system for evidence of leaks or spills

5. What are Other Common Issues with On Farm Fuel Storage?

Storing fuel on the farm poses some interesting challenges to producers in order to maintain the quality and quantity of the product. Changes in quality or composition of the fuel due to contamination or deterioration can create a great deal of aggravation for farmers. Fuel losses can occur from leaks and spills as well as evaporation or theft. It is important to monitor for these losses so that the proper action can be taken in the event of such problems. For more information on monitoring for fuel losses, refer to page 29 in the Appendix.

Contamination:

Common fuel contaminants may include:

- Water
- Sediment, rust, etc.

The major contaminant of stored fuel is water. It can enter the system through leaks, condensation, from the fuel supplier or through vandalism.

Minimal amounts of water from condensation in underground and on-ground gasoline tanks can be dealt with by adding the appropriate fuel de-waterer. In diesel tanks, use a quality diesel fuel de-waterer. There are also water-absorbing fuel filters available in the market place but these filters need to be changed regularly as the water-absorbing polymers that trap the water will restrict fuel flow when it is time to replace the filter element. If a large amount of water exists, the only alternative may be to have the water pumped out. Determining how the water entered the system is also important in detecting possible leaks. In overhead tanks, water can be drained by removing the drain plug on the bottom of the tank. This is best done when the tank is almost empty. Catch the contaminated water for proper disposal.

Common sediments in the fuel tank are minute particles of rust caused by water contamination. Other sediments are formed when fuels stored for a long period begin to break down. Sediments can cause filter plugging, engine deposits, gumming and lacquering which lead to component sticking and engine wear. At the very least, contamination of fuel causes lost time and aggravation. Contamination of your engine's fuel system can be minimized by not refueling within 24 hours of a fuel delivery. This will allow any small sediment particles to settle below the discharge height.

Overhead tanks should be checked annually for sediment. This is done by drawing off a litre of fuel from the fuel nozzle into a clear glass jar. If the sample is contaminated, ask your fuel supplier to co-operate by removing the entire contents and cleaning the tank. If the first sample is not contaminated, use a clean rod or stick to agitate the tank through the fill cap and draw off a second sample. If the second sample is contaminated, the tank should be cleaned at the first convenient opportunity.

Filters and sediment bowls on overhead tanks will minimize the chances of contaminating equipment fuel systems. The filter should have enough capacity to pass fuel at the usual rate of filling. The recommended size of filter is 10 microns. This size is sufficient for removing microscopic particles of rust, sand, dirt, scale and lint. Most fuel pumps are equipped with filter screens, which limit sediment contamination but require regular cleaning.

Figure 4: Fuel filter
Photo courtesy of Baldwin Filters

Other contamination occurs when fuel is delivered improperly or equipment is not properly fuelled. For example, gas mixed into diesel can cause extensive damage to diesel engines. Diesel fuel mixed into gas is generally not as serious a problem for gas engines.

Plastic tanks are not suitable for above ground fuel storage. Sunlight going through translucent tank walls promotes microbial growth and other fuel degradation. In addition, most plastic tanks are not strong enough for safe fuel storage.

Deterioration:

Fuel deterioration is minimized when fuel is stored at a cool, constant temperature. The larger the temperature swings and the higher the temperature, the faster fuel will deteriorate. Degraded fuel results in poor engine performance, less power, harder starting and lower fuel economy.

Tips to prevent deterioration:

- Keep fuel at as cool and consistent a temperature as possible (For example, shade tanks from the sun)
- Limit fuel purchases to the volume required to seed and harvest one year's crops (Not only to reduce deterioration, but to reduce risk and cost of leakage, fire and theft)
- Purchase diesel fuel in the season in which it is being used (summer diesel may gel and cause engine problems if used at low temperatures)

In the event of a price war, there is always the temptation to purchase as much fuel as possible. Those with underground storage tanks are in the best position to take advantage of low prices. Underground tanks provide the best long-term storage capabilities. However, before purchasing fuel for long-term storage, carefully consider the risks, interest costs, tax implications and your ability to maintain the fuel in good condition.

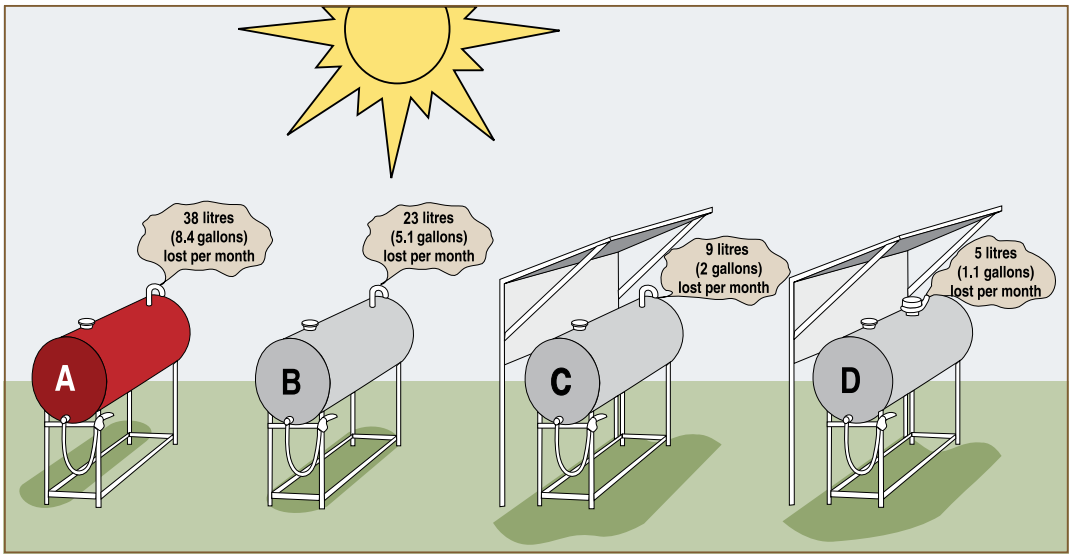
Evaporation:

Evaporative losses vary with the type of storage, type of fuel and steps taken to prevent evaporation. Losses range from minimal in underground tanks to easily measurable in poorly located and maintained overhead tanks. The greater the variations in temperature of the fuel, the greater the potential loss and the larger the risk of contamination due to condensation. Table 1 and Figure 5 illustrate this variance in evaporative losses.

Table 1: Evaporative losses from 1200 litre (265 gallons) above ground gasoline storage tanks

TANK CONDITIONS	EVAPORATION LOST PER SUMMER MONTHS		% OF FULL TANK LOST
	LITRES	GALLONS	%
Dark tank in sun	38	8.4	3.2
White tank in sun	23	5.1	1.9
Dark tank in sun with pressure vent cap	21	4.6	1.8
White tank in sun with pressure vent cap	12	2.6	1
Dark tank in shade	9	2	0.8
White tank in shade with pressure vent cap	5	1.1	0.4
FOR COMPARISON PURPOSES:			
Underground tank	‹ 4	‹ 1	
Double walled above ground tank	Losses similar to underground tank		

Referenced from University of Nebraska, 1981 and British Columbia Ministry of Agriculture and Lands, Farm Storage and Handling of Petroleum Product, June 2005



A - Red tank exposed to sun's heat
B - White or silver tank exposed to sun's heat
C - White tank protected by a shade
D - White shaded tank equipped with a pressure/vacuum relief valve

Figure 5: Summer evaporation losses from 1,200 litre (265 gallons) gasoline storage

Steps to reducing evaporation losses:

1. By painting the tank a reflective paint (silver or white), evaporation losses can be reduced by up to 40% over a dark tank.
2. Using a pressure-ventilated cap can reduce evaporation losses a further 50%. Direct venting of the tank fumes is restricted until a slight pressure has built up in the tank. Having a painted and pressure vented tank has a 75% evaporation loss reduction compared to a dark tank.
3. Placing a painted and pressure vented tank in the shade will further reduce the evaporation losses by over 40%. The roof also helps reduce weathering of hoses and valves.

Resource Management Branch, BC Ministry of Agriculture and Lands

Evaporative losses are not a major concern in underground tanks and are only of minor concern in larger, on-ground tanks. The large volume of fuel and air helps to maintain a more even temperature. Owners should ensure that proper pressure-vacuum relief valves are installed on tanks. These valves will reduce evaporation while allowing vapours to escape before tank pressures become excessive.

Theft:

Theft is a frustrating and difficult situation to deal with. Theft of fuel can vary from a nuisance factor to a substantial financial cost. Being an easy target for fuel theft can lead to further theft and vandalism on the farm, and larger losses. Keep track of fuel purchases and usage to know if there is an unexplained disappearance (see also *Monitoring for Fuel Losses* in the Appendix).

Tips for theft protection include:

- Locate tanks in a well lit area away from buildings and not visible from roads but still visible from your house
- Close and lock the valves on all on-ground and overhead tank outlets when not in use
- Lock fuel caps on underground tanks
- Turn off power to pumps (have switch in a locked building)
- Consider using hoses that are fitted with cam lock fittings and removed when not in use
- Some producers have used lockable nozzle racks as well as locking valves

Figure 6: Cam lock fitting

Transportation:

According to the Transportation of Dangerous Goods (TDG) Regulation, the following precautions must be taken when transporting fuel tanks. No documentation or training is required when the following conditions are met:

Table 2: Summary of requirements for various sizes of portable tanks for gasoline and diesel

PRODUCT	TANK SIZE		REQUIREMENTS
	LITRES	GALLONS	
gasoline safety	450 or less	100 or less	UN #, shipping name and label (class 3) must be displayed
diesel	450 or less	100 or less	not regulated
gasoline	more than 450, but less than 2000	more than 100, but less than 440	Class 3 safety placard must be displayed
diesel	more than 450, but less than 2000	more than 100, but less than 440	Class 3 safety placard must be displayed

The total capacity of all containers on the vehicle must not be more than 2000 litres. For containers exceeding this, full compliance is required. For further information, contact Alberta Transportation and Utilities.

For example, for a portable tank containing gasoline, the UN number is "1203" and the shipping name is "gas" or "gasoline". Also keep in mind your local fire authority may have regulations on parking in town with portable fuel tanks, and it varies by municipality. Parking of vehicles with slip tanks is not permitted in residential areas.

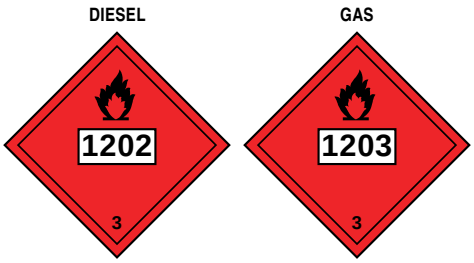


Figure 7: Placards showing flammable symbol, class, UN number and shipping name

Figure 8: Portable tank with proper signage, etc. Photo courtesy of Westeel

It is recommended that both dangerous goods placards and WHMIS labels be used when transporting fuels. These labels and placards can be purchased through fuel suppliers or at safety supply stores.

Tip: When refueling from slip tanks, remember the dangers of static electricity. You can prevent this by grounding your tank. (See section 7, *Planning a Fuel Storage Site*) Also, if your tank is equipped with a 12-volt pump, be careful to keep all electrical systems properly maintained to prevent sparks.

The TDG Regulations do not apply to dangerous goods in a quantity less than or equal to 1500 kg gross mass in transport on a licensed farm road vehicle if:

a. The dangerous goods are transported on land for a distance less than or equal to 100km,
b. The dangerous goods will be used or have been used for agricultural purposes, and
c. The dangerous goods do not include:
    i. Explosives
    ii. Flammable gases in a cylinder with a capacity greater than 46L
    iii. Toxic gases
    iv. Infectious substances, or
    v. Radioactive materials.

Even though the transport of most fuel in "slip tanks" for farm use would be exempt from the TDG Regulation as described above, it also provides a reasonable set of guidelines for farmers to use in order to reduce their risk.

6. What Types of Fuel Storage Systems are Available?

The objectives of fuel storage are to maintain fuel quality and minimize losses in a safe manner. There are several on-farm storage options classified as underground and above ground. Above ground systems include on-ground and/or overhead tanks.

Underground tanks are completely buried with only the pumps, vents and fill connections visible. There are two types of on-ground tanks. Vertical, on-ground tanks are usually cylindrical in shape and have their bottoms sitting directly on the ground. These are not as common as a horizontal tank is on the farm. Horizontal, on-ground tanks are cradled close to the ground in a heavy steel frame. An on-ground tank must be equipped with a pump for fuelling vehicles and farm machinery. The third type is overhead tanks. They are supported above the ground on stands and the fuel is gravity fed.

Table 3: Comparison of above ground storage tanks (AST's) and underground storage tanks (UST's)

TANK SYSTEM	ADVANTAGES	DISAVANTAGES
ASTs	System can be visually monitored for leaks or corrosion, allowing for an effective response	Increased fire hazard
	Repairs are quick and less expensive	May require vapour recovery system
	Minimal excavation required	Increased risk of vandalism or accidental vehicular collision
	Installation slightly less expensive	Can be aesthetically undesirable
		Takes up additional space
		Tanks exposed to adverse weather conditions; additional wear may result
		Tank exposed to pressure and temperature fluctuations
USTs	Do not require any surface space	Repairs are more difficult and expensive
	Less of an aesthetic concern	Releases and corrosion can go undetected
	Tank sheltered from adverse weather conditions	Extensive excavation required for installation
	Reduced fire hazard	Greater corrosion risk for steel tanks & piping
	May not be required to control the release of volatile organic vapours	Underground piping subject to breakage with freeze and thaw stresses

Storage Tank Management Systems, Public Works and Government Services Canada, adapted

Above ground storage tanks:

Traditionally, many farms used the overhead, gravity fed type systems that would not comply with the AFC. Because of the large expense often associated with new on-ground tank systems (the most recommended), many producers are looking for ways to upgrade their existing systems. This publication will also provide some suggestions and ideas for farmers looking to decrease their risk associated with these tanks. However, if a producer chooses to use their existing tanks with some upgrades, it may still not meet all of the AFC requirements.

Underground storage tanks:

Under the AFC new underground fuel tanks must be installed by an approved contractor. While farmers are exempt from the AFC, there are compelling reasons why an approved contractor should be hired. Some protection is provided by the contractor's insurance if a leak or malfunction

can be traced to the installation. If a farmer installs his own tanks, his risk is extended to include both the owner's and the installer's liabilities. The Petroleum Tank Management Association of Alberta (PTMAA) has a list of approved contractors. See the *For More Information* section in the Appendix for contact details.

According to the AFC, all new underground construction must include:

- Cathodic protection on steel tanks and piping
- Tank leak detection (monitoring wells or acceptable means of monitoring of secondary containment, ATG, etc.)
- Line leak detection (single, vertical check valve on suction, mechanical or electronic leak detectors on turbine systems, sump monitoring)
- Under-dispenser sumps
- Spill containment on fill pipes (liquid-tight fill buckets)
- Over-fill prevention devices (95% maximum tank capacity)
    - Liquid-tight fill couplings (cam-lock connections)
- New, underground Class A[4] construction must also include secondary containment on tanks and piping. Class B systems can be installed with single wall tanks and piping.

Overview of Regulations, PTMAA

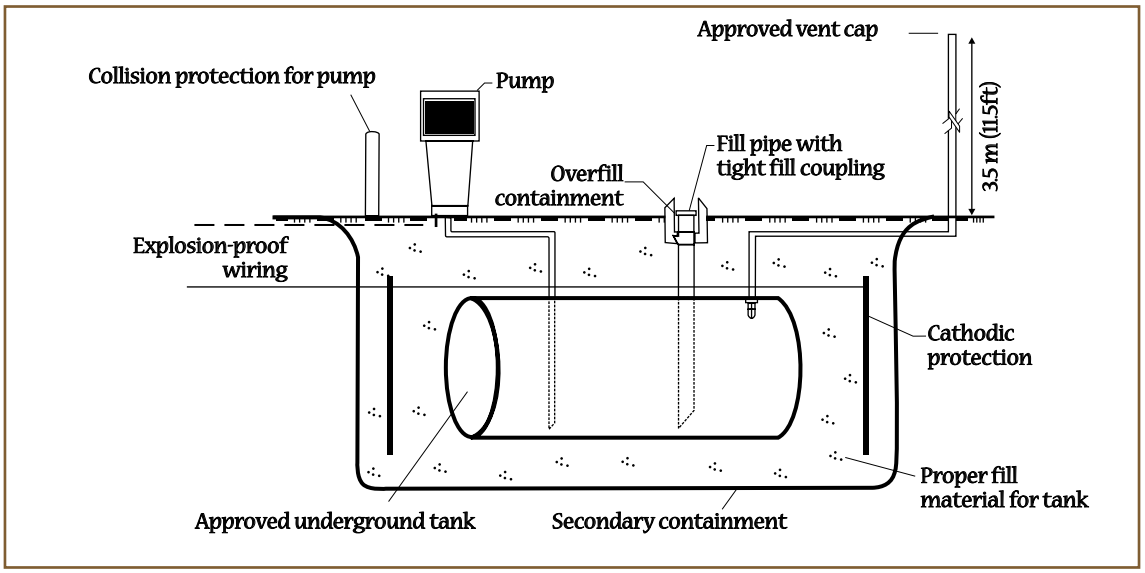


Figure 9: Underground storage tank[5]

[4]Class A sites include underground fuel tanks that are within 500 metres (1640 feet) of a water well or 200 metres (650 feet) from a surface water source. All other underground fuel tanks are considered Class B sites.

[5]This figure is for illustration purposes only. Although most major components are shown, some installations will require additional devices/equipment in order to be in compliance with the Alberta Fire Code.

7. Planning Your Fuel Storage Site – What You Need to Know

When planning a petroleum storage site, there are many design criteria to consider. As mentioned in Section 3, the AFC provides a good set of guidelines for farmers to follow when designing a fuel storage system.

These guidelines include:

- ULC-approved tank construction
- Secondary containment
- Proper location
- Foundation and supports
- Collision protection
- Grounding for prevention of static electricity
- Pumps, venting, valves, etc.
- Emergency plan and equipment

This section will outline these design criteria in greater detail so that you can plan your own fuel storage site.

ULC-approved tank construction:

The Underwriters' Laboratories of Canada (ULC) is an independent, not-for-profit product safety organization. A ULC-approved tank has been tested and approved for safety. In order to meet the Alberta Fire Code requirements, all petroleum storage tanks need ULC certification, indicated by a placard or sticker on the tank.

Figure 10: ULC Mark

Secondary containment:

Secondary containment is recommended to accommodate accidental spillage or leakage. The total capacity of the containment must be 110 percent of the maximum volume of the storage tank. If there is more than one tank, then the containment must hold 110 percent of the largest tank, or the capacity of the largest tank plus 10 percent of the total volume of the remaining tanks, whichever is greater.

Secondary containment can be achieved either by:

A. Installing a double walled tank
B. Using a diking system with an impermeable barrier or other premanufactured containment systems

A. Double walled tanks:

Double walled tanks provide excellent protection against leaks, spills, and evaporation losses. These tanks have a built-in secondary containment which is the space between two walls that

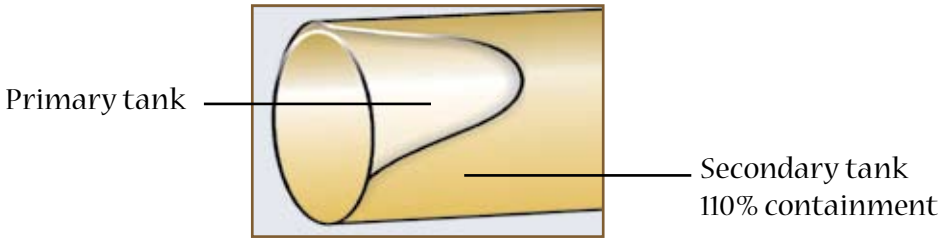


Figure 11: Diagram of double wall construction

contain the fuel in the event of a leak or rupture of the interior wall.
Some double walled tanks have a vacuum seal between the two walls with a pressure/inspection gauge that allows the owner to monitor the seal. If the interior wall produces a leak, the vacuum seal will be broken and will be indicated on the gauge. Other styles of double walled tanks allow the operator to visually inspect a chamber connected to an interstitial space.

Figure 12: Double wall vacuum monitoring gauge
Photo courtesy of the Alberta Environmental Farm Plan, 2006

Double walled tanks can be equipped with an integral pump system providing excellent protection against leaks. The double walls provide some thermal insulation value reducing swings in fuel temperature. Installation is reduced to finding a suitable location, preparing a firm foundation and providing electrical power using wiring suitable for Class I hazardous locations. (Refer to the Electrical Code). The fuel can be secured by shutting off the power to the pumps. The biggest drawback is the purchase price. This must be weighed against the advantages to determine if these tanks meet your needs. They are available in horizontal and vertical models

Figure 13: Double walled, on-ground tank (horizontal model)
Photo courtesy of Westeel

B. Diking with impermeable barrier or other premanufactured containment systems:

An alternative to double walled tanks would be using a dike with an impermeable barrier or tub as secondary containment. Materials used should be non-combustible and impermeable such as compacted clay, concrete or steel with a liner made of a compatible synthetic material such as plastic. Earth dikes must have a flat top, not less than 600 mm (2 feet) wide and be at least 600 mm (2 feet) high.

The side slope should be natural for the material used. The floor of the containment must also be impermeable and sloped to a sump.

Since the containment is designed to hold 110 percent of the tank's capacity, rainwater and other materials must be kept out or evacuated. If water has accumulated and is contaminated from minor leaks and spills, you can use a hydrocarbon absorbent (see *Spill Kit* section on page 28 in the Appendix) to absorb only the fuel and not the water. Then you can safely dispose of the fuel/absorbent and the clean water. Figure 14 shows an example of a suitable diking system. An alternative that is available would be a premanufactured containment such as a tub, tray or a fully enclosed system, as illustrated in Figure 15.

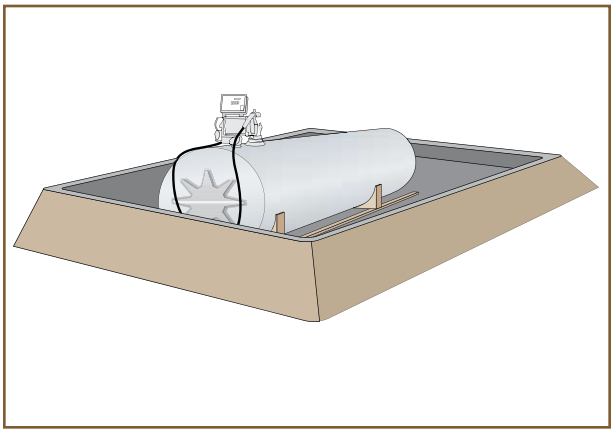


Figure 14: On-ground tank with containment dike

Figure 15: Fully enclosed secondary containment system
Photo courtesy of Canadian Enviro-Tub Inc.

Location:

The proper location of a fuel storage system is very important in order to reduce the risk of fire, collisions, theft, and environmental impacts. The recommended separation distances from a petroleum storage tank are illustrated in Figure 16.

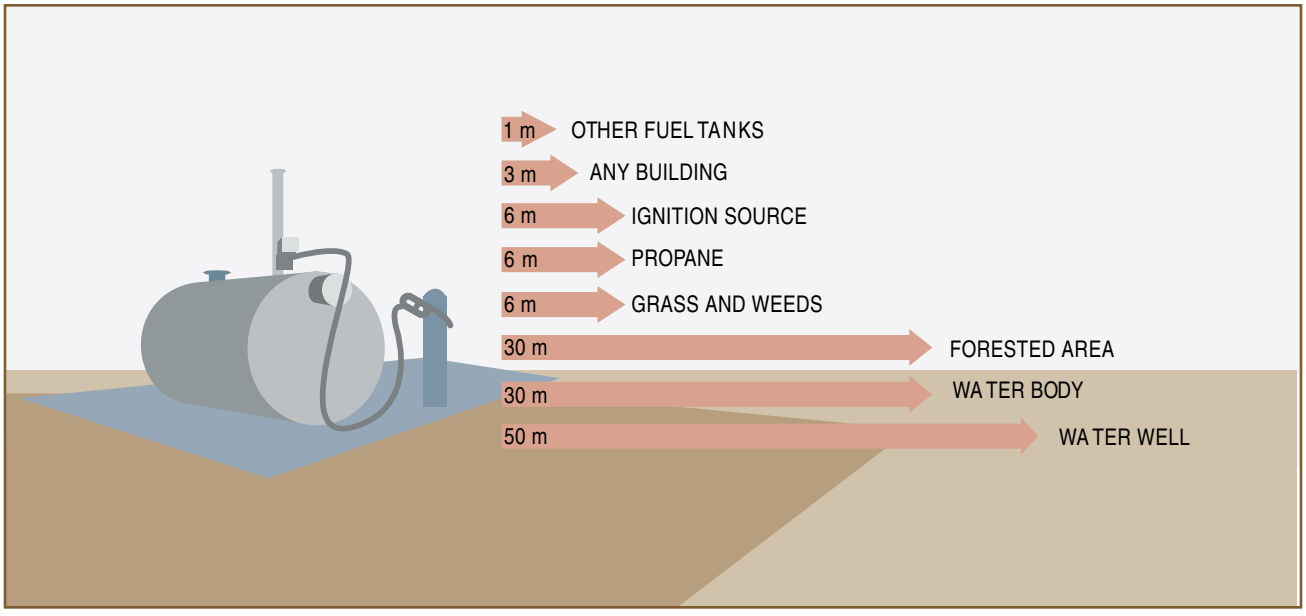


Figure 16: Minimum separation distances from petroleum storage

Foundation and supports:

When preparing a site for fuel tank storage systems, a solid foundation is important to prevent any uneven settling. Concrete, compacted clay or gravel are all good choices as material for the foundation. The foundation area should also be kept clear of weeds or other debris that may pose a fire hazard. See Figure 17 for an example of a suitable foundation and supports.

The metal stands typically used on many Alberta farms do not comply with the AFC. According the AFC, all supports (except those less than 0.3 m high at their highest point) must provide a fire resistance rating of no less than 2 hours. The best practice is to mount at ground level or on solid concrete or steel supports no higher that 0.3 m (1ft) off the ground.

Figure 17: Double walled tanks using concrete supports on firm, compacted gravel
Photo courtesy of the Alberta Environmental Farm Plan Company, 2006

Collision protection

The most common major leaks and spills are usually the result of vehicles or equipment colliding with petroleum tanks. For this reason, it is recommended that barriers are placed around the fuel storage site to prevent these accidental spills. The barriers can be in the form of bollards, or posts, either made of steel, concrete or heavy timber. Other effective ways to prevent collision with the tanks could include jersey barriers or large concrete curbs. Another example as shown in Figure 18 is to use large boulders to protect the tank, doubling as decorative feature as well.

Figure 18: Collision protection using large boulders
Photo courtesy of MFP Mohawk Fuel Products Inc. and Scott Stack, 2006

Grounding for prevention of static electricity:

Static electricity can be a form of ignition. Two common causes of static electricity are the movement of grains though an auger and the movement of vehicles or machinery. Any time there is an imbalance in electrical charges between two objects, a spark can occur when they come in contact or close proximity. If the gasoline nozzle is the contact point between the fuel storage tank and a static-charged vehicle or farm machine, a spark may ignite any fuel vapours present. It is recommended that a bonding line be connected between the storage tank and the vehicle before the dispensing process has begun (Figure 19). A flexible, copper conductor, 12 gauge or larger, is recommended.

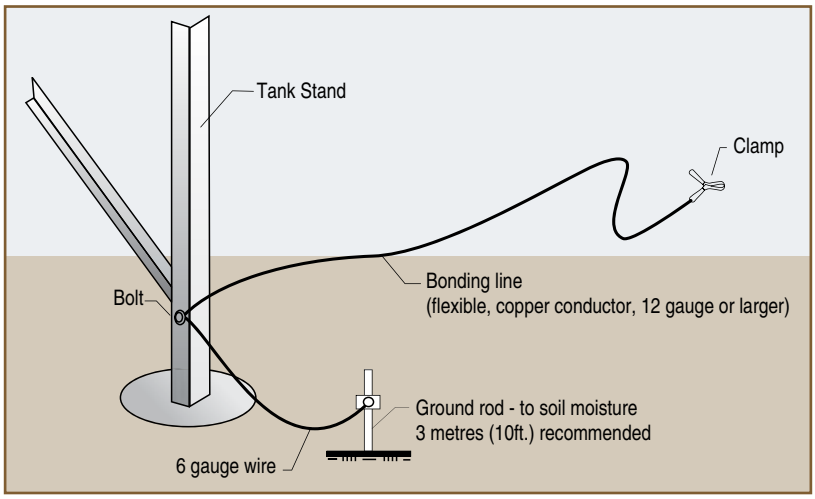


Figure 19: Bonding line and proper grounding of fuel tank supports

Pumps, venting, valves, etc.:

Ensure pumps and meters are ULC approved and suitable wiring is used (for Class I hazardous locations, as outlined in the Electrical Code). Venting is an important aspect of proper fuel storage as well to prevent the build of pressure in the tank. The risk of accidental spills and leaks can be greatly reduced by the installation of ULC and CSA approved dispensing units and automatic shut off valves.

Figure 20: ULC approved pump and meter

The use of anti-siphon valves is also recommended. Installed between the pump and tank, these valves prevent the tank from draining if the line is broken. Lines are commonly broken in the event of a collision with the pump. Another recommendation is to use a valve equipped with a fusible link. In the case of fire, the link melts, closing the valve and shutting off the flow of fuel.

Emergency plan and equipment:

An emergency plan consists of the identification and location of hazardous materials, emergency equipment, telephone numbers and necessary clean-up methods. This plan gives the residents of the farmstead guidelines for minimizing potential environmental damage to the site, as well as protecting themselves and the surrounding community. Emergency response teams should also have access to the plan to help them distinguish between response procedures for different situations. For more information on creating an emergency plan, refer to the Appendix.

8. What Do You Do With the Old Tanks?

Because of the inherent risk associated with fuel storage, many property owners are choosing to replace their old tanks or remove them all together, especially underground tanks. This section will outline the step farmers should take in order to properly handle this task. There are two main options that a producer can choose from when removing old tanks: recycling via a scrap metal dealer or disposal in a licensed landfill.

Figure 21: Example of an inadequate fuel storage system
Photo courtesy of Alberta Environmental Farm Plan Company, 2006

Tank recycling:

There are some scrap metal dealers that will accept used fuel tanks for recycling, but usually it is required that they be steam cleaned and have holes punched or cut through to ensure that there is no vapour build up. Recycling used fuel tanks can end up being a costly and time consuming process and, there is no guarantee that the producer will get scrap value for their tank. Many dealers will accept them but don't offer payment in return.

Tank disposal:

Disposal in your local licensed landfill may be an alternative, depending on the site's policies. Some landfills will accept old fuel tanks for disposal while others will not. Checking ahead with the landfill management for their policy on accepting these items may save you valuable time and travel.

Because of the inherent costs and time involved in proper disposal of bulk fuel tanks, selling them to another producer may seem enticing. Although this practice in not encouraged, there are a few things for a producer to keep in mind in order to mitigate some of the risks associated with selling used bulk fuel tanks. First and foremost, ensure that it is not to be used for anything other than fuel storage. It is also a good idea to provide some suggestions to the new owner about secondary containment, proper setback distances and safe fuel handling practices. If a producer is contemplating the purchase of a used fuel tank, he or she should keep the same considerations in mind and try to address any environmental concerns that may arise.

9. Emergency Procedures

Fire:

In the event of a petroleum fire:

- Contact the local fire department – 911
- If safe to do so, remove any injured people to a safer site possible, generally upwind from the fire.
- If there is a danger of explosion, get away!
- If safe to do so, stop the flow of fuel feeding the fire
- Remove on-going sources of ignition i.e. shut off the electricity
- Attempt to extinguish flames using approved equipment (Purple K type fire extinguisher)
- If a person who is splashed with fuel catches fire, wrap him in a blanket or roll him on the ground to remove oxygen and extinguish the fire. If this doesn't work, use a Purple K dry chemical fire extinguisher to put out the fire.

Not all fire extinguishers are the same. First you need to know what type of fire you are dealing with:

Class A – ordinary combustibles such as wood, paper, cloth, plastic, etc.
Class B – flammable and combustible liquids such as grease, gas, oils, paints, etc.
Class C – electrical equipment such as appliances, computers, breakers, motors, etc.
Class D – burning metals such as aluminum, magnesium, sodium, etc.

Each type of fire requires a different type of extinguisher:

Pressurized Water – Class A fires only

Dry Chemical – Class ABC fires. Include Type ABC, Type BC and Purple K fire extinguishers

Carbon Dioxide (CO_2) – Class B and C fires only. These don't leave harmful residues behind like dry chemical extinguishers

Metal or Sand – Class D fires only. The most common extinguishing agent in this class is sodium chloride, but there are a variety of other options

It is vital to know what type of extinguisher you are using. Using the wrong type of extinguisher for the wrong type of fire can be life-threatening. It is also imperative that inspection and service of your extinguisher is done on a regular basis to ensure the device operates properly when needed.

Leaks or spills:

In the case of spills, those living and working on the farmstead need to be responsible for minimizing environmental and safety risks by following these steps:

1. Isolating the affected area
2. Wearing protective clothing
3. Ventilating the area

4. Stopping further leaks
5. Containing the spill area
6. Reporting the spill
7. Cleaning the spill
8. Decontaminating the spill area
9. Disposing and reclaiming the waste

To ensure human health and safety, protect the environment and prevent a more extensive problem, report all spills to Alberta Environment (immediately if entering or threatening a water body or source). Reporting a spill provides information if clean-up is required. It also provides a record in case the incident is reported by someone else and leads to an investigation that may result in costly sample taking and associated chemical analyses to determine what has been spilled.

In the case of a non-hazardous, accidental spill, it is always a good idea to carry a supply of fresh water and a clean pair of gloves to wear when cleaning up. First, it is important to read any product labels or contact the manufacturer for advice on clean-up procedures (most products have a 1-800 customer service number on the label). Disposing of all absorbent materials must be done in an approved landfill. If the spill is large, evacuate the area and notify Alberta Environment.

To Report a spill, contact:

Alberta Environment's Emergency Response Centre
1-800-222-6514

Contaminated soil:

There are a couple of methods commonly used to deal with contaminated soil: land spreading and landfill.

A. Land spreading

This involves composting of the contaminated soil that is spread on a suitable field surface. Soil microorganisms break down the hydrocarbons as the material is periodically turned and mixed with organic matter (eg., manure). Before attempting this method of treatment, ensure that runoff is controlled and that there is a minimal risk to groundwater contamination (i.e. water table protected by natural clay barrier, etc.). Land treatment of contaminated soils should be done between April and November, weather permitting. Outside of this time period, the contaminated soil can be stockpiled if adequate precautions are taken to prevent leaching of contaminates from the soil into the underlying soils and runoff.

It is recommended that you seek professional advice when considering land treatment of contaminated soils. Also refer to the *Alberta Code of Practice for Land Treatment of Soil Containing Hydrocarbons*, made under the EPEA.

B. Landfill

Contaminated soil can be hauled to an approved landfill. Contact your local landfill to ensure that the site accepts such material.

10. Are There Special Considerations for Storing and Handling Biofuels?

Ethanol and biodiesel are the two main types of biofuels. Ethanol is produced from carbohydrates using a fermentation – distillation process. Biodiesel is a renewable fuel manufactured from vegetable oils, animal fats and recycled cooking oils. The most common use for these biofuels is as additives: ethanol is blended with gasoline and biodiesel with petroleum diesel. For ethanol, blends up to E10 (10% ethanol) are quite common since it requires no engine modifications. For biodiesel, blends of B2 – B20 (2 - 20% biodiesel) are commonly used in Alberta. Blends higher than B20, up to B100 (100% biodiesel) are not as common, mostly due to cold weather issues.

Ethanol-blended gasoline:

For the most part, ethanol blended gasoline can be handled and stored in the same way that gasoline is. Steel tanks are compatible with ethanol blended fuel storage; however, ethanol has a few characteristics that are quite different than gasoline. These features affect the storage of these blended fuels. The first is ethanol's tendency to be a solvent and second is its high affinity for water. Because of this, there are a few simple steps to follow ensure fuel quality and safety.

First, ensure storage tanks are clean before using for ethanol blends. A tar like substance tends to accumulate over time in gasoline storage tanks and this can be loosened in ethanol-blended gasoline. These deposits can then accumulate in fuel filters and could lead to engine performance problems. To ensure fuel quality, existing gasoline storage tanks should be thoroughly cleaned prior to first fill of ethanol blended fuel.

Second, ensure that there is no water in the tank. Water contamination of ethanol-blended fuel can lead to phase separation, where the ethanol separates from the gasoline and mixes with the water. This will lead to a poor quality gasoline. Prevention of water contamination in ethanol-blended gasoline is extremely important.

Lastly, install filters on fuel dispensers. Using a 10 micron filter on the dispenser will reduce filter clogging on equipment, catching any deposits that may have accumulated since the initial cleaning.

Biodiesel (B20 blends):

Considerations for the storage of biodiesel are very similar to that of petroleum diesel as most tanks designed to store diesel fuel are adequate for biodiesel. Acceptable storage tank materials include aluminum, steel, fluorinated polyethylene, fluorinated polypropylene, teflon, and most fibreglass materials.

The effects on hoses, gaskets, seals, glues and plastics using biodiesel blends of B20 or less have shown to be very small. For low-level blends such as B2, the effects are virtually non-existent. It is recommended that when handling blends of B20 or less, regular monitoring of hoses and gaskets for leaks would be sufficient.

B20 blended biodiesel can typically be used as a direct replacement for No.2 petroleum diesel in diesel engines. Over time, rubber components may degrade and need to be replaced. Storage in hot humid conditions may lead to increased fuel degradation, but this can be addressed by using double walled tanks, shade, or biocide additives.

Cleaning Effect:

Biodiesel is a solvent. Any sediments or deposits left in existing storage tanks used for petroleum diesel may become dissolved in the biodiesel. The level of "cleaning" depends on the amount of sediment in the system, as well as the blend of biodiesel. The cleaning effect will be much greater for B100, and minimal for B20 blends. Sediments may plug fuel filters for the first few weeks of using B20 biodiesel. Keep some extra filters on hand and monitor potential filter clogging a little closer than normal when first starting up with B20 blends. For B100, it is recommended that exiting tanks and fuel systems be cleaned before handling or using B100.

Biodiesel (B100):

The major issue with storing and handling B100 biodiesel, especially in Canada, is the temperature factor. The cloud point of B100 ranges from 3 – 15 degrees Celsius. The clouding can lead to plugged lines and filters. As the biodiesel starts to gel, pumping equipment becomes stressed due to the increased viscosity of the biodiesel. Because of this, heated and insulated tanks, lines and pumps are needed for handling B100 biodiesel.

There are also some metal compatibility issues when storing B100 biodiesel. Brass, bronze, copper, lead, tin and zinc may cause the oxidation of biodiesel, creating fuel sediments or gels and salts. For this reason, lead solders, zinc linings, copper pipes and fittings, and brass regulators should be avoided. Affected equipment should be replaced with stainless steel, carbon steel, or aluminum. Using blends of B20 and lower will greatly reduce the impact of these issues.

With blends greater than B20, biodiesel compatible gaskets and elastomeric materials are highly recommended. B100 may degrade some hoses, gaskets, seals, glues and plastics with prolonged exposure. Natural or nitrile rubber compounds, polypropylene, and polyvinyl materials are particularly susceptible. Teflon, viton and hylon are among the materials that can be used to update incompatible equipment. Before handling or using B100 biodiesel it is highly recommended that you contact the equipment manufacturer to determine its compatibility.

11. Appendix: Frequently Asked Questions

Q: Do I need a berm and double walled tanks?
A: No. According to the guidelines set out by the AFC, only one extra barrier of containment is necessary. A double walled tank has the secondary containment built in the construction of the tank.

Q: How long can you store fuel?
A: There is no single answer to this. For all fuels, it depends upon the condition under which it is stored. Generally, gasoline is recommended to be used within a month of purchase. To maximize the storage, keep the tank nearly full (to minimize air contact and to allow for expansion) and in a cool environment (slowing down the rate of oxidation). Under these conditions, gasoline would be expected to remain of good quality for at least 6 months. Installing double walled tanks and/or using fuel stabilizer will help extend the storage life of gasoline. Diesel fuel, kept clean, cool and dry, can be expected to last longer, from 6-12 months. Periodic filtrations and addition of fuel stabilizers and biocides can also accomplish storage for longer periods.

Q: Are all farms exempt from the fire code?
A: Fuel storage used solely for agricultural purposes is exempt from the code. However, fuel storage used for other commercial activities (including operating a school bus, grader, construction equipment, etc.) would not be exempt.

Q: What are the requirements for the storage of propane tanks?
A: According to the fire code, propane tanks and cylinders should be stored no less than 6 metres away from petroleum tanks. In addition to this, propane cylinders and tanks are not permitted within the secondary containment area of the petroleum tanks. The distance between a propane cylinder and the centre of the containment wall must be no less than 3 metres and no less than 6 metres for propane tanks.

Q: What are the requirements for the storage of Jerry cans?
A: Jerry cans (or other small container storage) must be ULC or CSA approved. Jerry cans used for fuel storage should be kept at a minimum and should not be stored in a dwelling. If stored in a building, the maximum amount of gasoline allowed (according to the fire code) is 30 litres, and the maximum amount of diesel is 150 litres. However, if stored together, the quantities allowed are derived from the following formula:

$$\frac{Gasoline}{30\ litres} + \frac{Diesel}{150\ litres} \leq 1$$

For example, if the amount of gasoline stored was 20 litres, the allowable volume of diesel storage would be 50 litres. A suggestion for storage of Jerry cans would be to use secondary containment. This could be as simple as placing the Jerry cans into plastic or rubber tub to prevent minor spills or leaks from contaminating other areas during storage or transport.

11. Appendix: Emergency Plan and Spill Kit

Mapping out your farmstead site may be a good first step to identifying potentialy hazardous areas (see Figure 22). The following diagram outlines where all buildings are located in proximity to roads, dugouts, fuel tanks, corrals or animal shelters. Main power poles with transformers and breakers should also be included. In addition, be sure to include anything that can become a hazard on the map:

- compressed gas storages (oxygen, acetylene and air tanks)
- fuels and oils
- electrical, gas and water shutoffs
- water well locations (including abandoned and unused wells) and water sources (including dugouts)
- fertilizer and pesticide storages, as well as mixing and loading areas
- compost and manure storage areas
- farm waste storage areas
- septic systems
- fire fighting equipment such as fire extinguishers

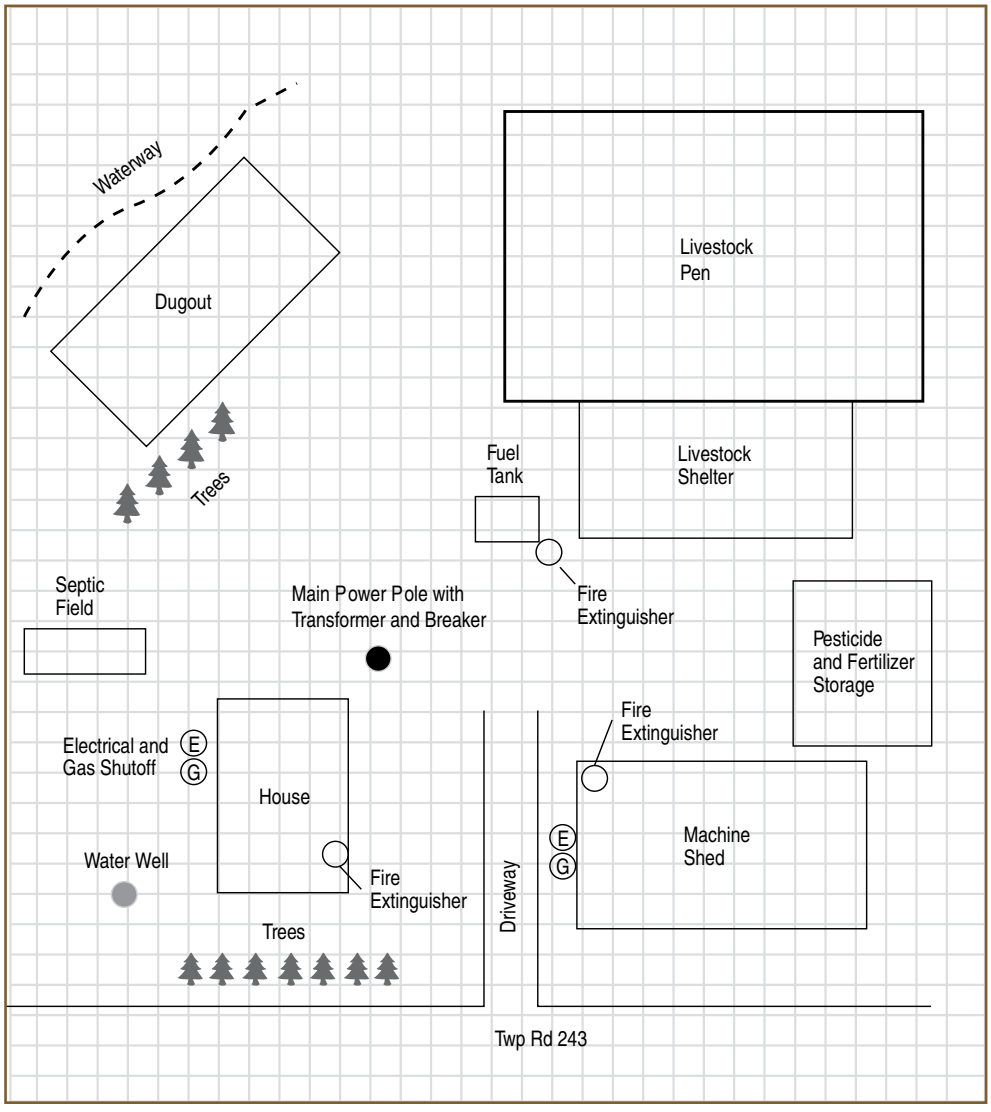


Figure 22: Example of a farmstead map as part of an emergency plan

Rural emergency plan:

The Rural Emergency Plan (REP) is a safety program launched by the Alberta Environmental Farm Plan Company and the Alberta Fire Chiefs Association. It is aimed at protecting rural landowners, their families and emergency personnel in the event of a fire or other emergency. The REP includes farmstead site map, a list of special considerations for your farm, a inventory of hazardous goods, a list of emergency equipment and supplies, a site runoff map, emergency contact information, and a water tight containment tube. REP templates and forms can be obtained by contacting your local fire department, or visiting the website, AlbertaEFP.com.

Spill kits:

Emergency spill kits can be purchased through various emergency and safety supply centres or you can build them yourself.

The main components of a spill kit should include:

- Personal Protective Equipment (PPE). Includes gloves, eye protection, Tyvek suit, etc.
- Hydrocarbon absorbent. Various types are available, depending on the intended use, but one that won't absorb water is recommended. These are available in loose form or prepared into absorbent "socks".
- Warning or caution labels and signs
- Emergency procedures
- Shovel
- Eyewash kit

Figure 23: Emergency spill kit
Photo courtesy of Alberta Environmental Farm Plan Company

		TANK 1
Fuel Type		
Fuel Dips (Fuel Depth in centimeters)		97
Volume in Litres (Converted from chart)		2054
Opening Inventories		1710
Deliveries	+	500
Sub-Total	=	2210
Usage	-	162
Expected Inventory	=	2048
Actual Inventory (from dips)		2054
Expected Inventory	-	2048
Today's Variance*	=	+6
Previous YTD Variance*	+	-52
YTD Variance*	=	-46

This value is determined by dipping your tanks with a measuring rod or tape. The measurement is taken in centimetres.

This value is determined from the chart supplied by tank manufacturers. For this example, a depth of 97 centimetres converts to a volume of 2054 litres.

Obtained from actual inventory figures on your last inventory sheet.

Fuel delivered since last inventory sheet.

Opening inventor plus deliveries.

Fuel removed from the tanks since last inventory sheet.

The amount of fuel you expect to be in your tank (sub-total minus usage).

Actual fuel in the tank as calculated able from fuel dip.

This figure is the expected inventory as calculated above.

The difference between actual inventory and expected inventory.

Cumulative year to date variance from the last inventory sheet.

Current year to date variance. (YTD – year to date)

*A negative variance indicates a fuel shortage.

Figure 24: Sample fuel inventory control sheet

11. Appendix: For More Information:

Alberta Agriculture and Rural Development
Ag-Info Centre: 310-FARM (3276)
Website: www.agric.gov.ab.ca

Alberta Environment
General Inquiries: 780-427-2700
24 Hour Environmental Hotline: 1-800-222-6514 (to report spills or releases)
- *Reporting Spills and Releases*
- *Release Reporting Guide*

Website: www.environment.alberta.ca

Alberta Municipal Affairs
Safety Services: 1-866-421-6929
- *Alberta Fire Code 2006*

Website: www.municipalaffairs.alberta.ca

Alberta Transportation
Dangerous Goods and Rail Safety Branch: 1-800-272-9600
- *Dangerous Goods and the Agricultural Industry*

Website: www.infratrans.gov.ab.ca

Alberta Queen's Printer
Bookstore: 780-427-4952
- *Water Act*
- *Environmental Protection & Enhancement Act*
- *Code of Practice for Land Treatment of Soil Containing Hydrocarbons*

Website: www.qp.gov.ab.ca

Safety Codes Council
General Inquiries: 1-888-413-0099
Website: www.safetycodes.ab.ca

Canadian Standards Association (CSA)
General Inquiries: 1-800-463-6727
- *Canadian Electrical Code, Part I (20th Edition), Safety Standard for Electrical Installations*

Website: www.csa.ca

Canadian Farm Business Management Council
Publications: 1-888-232-3762
- *Planning for and Responding to Disasters in Canada*

Website: www.farmcentre.com

Petroleum Tank Management Association of Alberta
General Inquiries: 1-866-222-8265
- *Farm Tank Brochure*

Website: www.ptmaa.ab.ca

11. Appendix: Glossary and Acronyms

Adverse affect: means impairment of or damage to the environment, human health or safety, or property.

Cathodic protection: method of preventing corrosion to a metal surface by introducing another metal (anode) in the ground to create a corrosion cell in which the surface to be protected becomes a cathode. Deterioration or corrosion occurs at the anode (introduced metal). The cathodic protection may be of a sacrificial type.

Class IA (Fire Code): flammable liquids that include those having a flash point below 22.8 degrees Celsius and a boiling point below 37.8 degrees Celsius. (ie. gasoline)

Class II (Fire Code): combustible liquids that include those having flashpoint at or above 37.8 degrees Celsius and below 60 degrees Celsius. (ie. diesel fuel)

Class 3 (TDG): flammable liquids with a flash point less than 60.5 degrees Celsius.

Cloud point: Cloud point is the temperature during cooling at which wax crystals first form in the fuel. These crystals create a visible haze or cloud that can plug fuel filters in diesel engines. Without heating aids on the fuel filter and lines, the cloud point limit the low temperature operability of a diesel fuel.

Due diligence: Taking all reasonable steps to prevent the commission of an offence.

Flash point: the minimum temperature at which a liquid within a container gives off vapour in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Lower explosive limit (LEL): the minimum concentration of vapour in air at which the propagation of flame occurs on contact with a source of ignition.

Material Safety Data Sheet (MSDS): a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. Also contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. In Canada, every material that is controlled by WHMIS must have an accompanying MSDS that is specific to each individual product or material.

Secondary containment: containment that prevents any materials spilled or leaks from the primary storage tanks system from reaching the land or water outside the containment before cleanup occurs. It includes double walled storage tanks systems and impermeable membranes or liners.

Underwriters' Laboratories of Canada (ULC): is an independent, not-for-profit product safety testing and certification organization.

UN (United Nations) number: is a four-digit number that identifies hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc) in the framework of international transport.

Workplace Hazardous Materials Information System (WHMIS): is a comprehensive plan for providing information on the safe use of hazardous materials used in Canadian workplaces. Information is provided by means of product labels, MSDS and worker education programs.