# How to Build Cost-Effective Skid-Sprayers for Prescribed Burning

By Nick Garza and Charles Taylor

The decline of grassland and savanna ecosystems due to woody plant encroachment has led to an increase in restoration efforts largely focused on reintroducing an effective fire regime. However, reintroduction of fire into Texas ecosystems has not been easy, especially in the Edwards Plateau region, where fire has been suppressed since the development of the livestock industry. Implementation of an effective prescribed burning program requires rancher and landowner education and cooperation; it also requires prescribed fire training, sharing of proper equipment, reduced liability, and the ability of ranchers to gain experience on the fire line as well as writing burn plans and managing prescribed fires. Equally important in getting a sustainable fire program started is the ability to conduct prescribed burns under a wide range of environmental conditions (for example, conducting prescribed fire during burn bans). The formation of prescribed burn associations, such as the Edwards Plateau Prescribed Burn Association, has provided a framework for ranchers and other landowners to collectively manage all of these factors with the end result of a substantial increase in prescribed fire on Texas rangelands.[1]

## Proper Equipment

With the increase in prescribed burning in general, and burning during the hot, dry growing season in particular, more efficient and cost-effective fire suppression equipment is a very critical component. Most ranchers have livestock sprayers; however, through years of prescribed burning experience, it is readily apparent that these machines were designed for purposes other than use on the fire line. What is needed is portable, light-weight, slip-in spray units that can be transferred from one truck to another at a moment's notice. There are many commercial models of slip-in spray rigs on the market that have been used by fire departments. These are well-made and efficient but tend to be costly. Commercially manufactured spray rigs can range from $3,000 to $10,000 and up for skid-mounted products that slide into a truck bed. On most prescribed burns, a minimum of 2 or more 150–200 gallon spray rigs are needed on site that can deliver 10–30 gallons per minute. These units must be portable and reliable. In addition to these units other on-site storage tanks, smaller sprayers for 4-wheelers, and backpack sprayers should be available. A good rule of thumb is that you can never have too much water at a fire.

**Figure 1.** Slip-in unit showing 200-gallon tank, motor, pump, and hose.

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| Table 1. Sprayer parts and prices | | | |
|---|---|---|---|
| **Part** | | **Cost** | **Extension** |
| Poly tank | 200–230 gallon | $250.00 | $250.00 |
| Pump | 5.5 hp Briggs w/ 75 psi pump | $450.00 | $450.00 |
| Fittings | | | |
| | 2-inch nipple-close | $2.30 | |
| | 2-inch ball valve | $30.00 | |
| | 2-inch nipple-close | $2.30 | |
| | 2-inch Tee | $6.30 | |
| | ♂ Camlock × ♂ threads | $4.50 | |
| | 2-inch Camlock cap | $9.00 | |
| | 2-inch nipple-close | $2.30 | |
| | 2-inch union | $14.00 | |
| | 2-inch combination nipple | $2.50 | |
| | 2-inch ♀ Camlock × hose barb | $9.00 | |
| | 2-inch ♂ Camlock × ♀ pipe threads | $3.50 | |
| | 2-inch union | $14.00 | |
| | 2-inch street El | $6.00 | |
| | 2-inch to 1-inch bushing | $2.00 | |
| | 1-inch nipple-close | $1.30 | |
| | 1-inch Tee | $4.00 | |
| | 1-inch to 3/4-inch bushing | $1.30 | |
| | 1-inch ♂ Camlock × ♂ pipe threads | $3.50 | |
| | 1-inch Ball valve | $16.00 | |
| | 2-inch ♀ Camlock × hose barb | $9.00 | |
| | 1-inch ♀ Camlock × hose barb | $7.00 | |
| | 1-inch combination nipple | $1.50 | $151.30 |
| Hose | 20 feet of 1-inch red utility hose | $30.00 | |
| | 22 feet of 2-inch suction hose | $20.00 | $50.00 |
| Clamps | 3 worm drive hose clamps | $6.00 | $6.00 |
| Nozzle | 1-inch aluminum | $35.00 | $35.00 |
| Skid | 1-inch tubing, rods, grinding wheels | $110.00 | $110.00 |
| **TOTAL COST** | | | **$1,052.30** |

Pump stats: 1-inch hose open flow = 55 gpm; 1-inch nozzle heavy stream = 31 gpm; 1-inch nozzle tight stream = 9 gpm; and spray distance = 53 feet.

We have been building portable spray rigs for use by the Edwards Plateau Prescribed Burning Association for several years and have developed a reasonably priced unit ($1,050) that provides adequate protection for most situations. These units are built from easily obtained parts and have proven to be portable, easy to operate, and reliable (Table 1). The level of complexity of these units varies depending upon the needs or desires of the builder but can be customized to serve several uses.

Figure 1 shows a design that incorporates only those parts necessary for spraying water and drafting to refill this tank or another tank. Water can be sprayed using a 1-inch outlet for higher volume or using a ¾-inch hose bib connection when smaller volumes are needed. The schematic shows the basic intake and discharge of water but does not take into account length of connections and relative position of each part because that will depend upon size of the water tank, skid dimensions, and level of complexity in plumbing design. With each increase in pump complexity, more space will be needed to fit additional parts into a limited amount of space.

Our experience has shown that a 5–6 hp engine with a moderate pressure centrifugal pump (70–80 psi with nozzle flow of 10–30 gpm) and high volume (80–150 gpm at open flow with 2-inch inlet and outlet) is relatively lightweight and provides enough pressure and volume to be an effective fire-suppression rig. These units are readily available, and when given proper care will last for years. Centrifugal pumps also have several advantages over other types of water pumps. These pumps are not affected by back pressure and thus, bypass lines are not necessary for pressure control. However, if water is not sprayed periodically after a few minutes, a build up of heat can occur which can eventually damage the pump. We solved this problem by adding a ½-inch line with a ball valve from the tank to the discharge port. By opening this line slightly you provide water circulation without affecting water discharge significantly. Another simple solution would be to put the nozzle end into the tank and let water flow back to the tank when not spraying. Most centrifugal pumps can handle small solids (< 1/8 inch) as well, so fine-screen filters are not necessary; however, use relatively clean water and always use a 1/8-inch strainer on the suction line. The cost and maintenance on centrifugal pumps is relatively low. Pumps with an attached 5–6 hp engine can be purchased for $500–$600 and free standing pumps can be attached by pulleys to many horizontal shaft engines.


**Figure 2.** Polaris Ranger with 50-gallon tank and 1 ½-hp engine.

Tank size depends upon size of the vehicle and amount of space available. Our original designs called for a 150–225 gallon tank. This provides a reasonable amount of water and can be carried by most full-sized pickups. Recently, many burn association members have been driving smaller trucks, jeeps, and small 4-wheel utility vehicles (eg, Polaris Rangers) which have less payload capacity, so we are building centrifugal sprayers with smaller tanks and smaller pumps and engines (Fig. 2).

Fittings originally used to plumb the units were galvanized, if weight was not a great issue, to reduce rust. However, many plastic or composite fittings are available that are able to withstand the pressures of a centrifugal pump. These fittings are lighter and easier to put together than galvanized parts and are often less expensive. The use of "Cam Action" or "Quick Couple" connections make assembly and disassembly much easier as well.

Most pumps in the horsepower range we use come standard with 2-inch intake and discharge ports (Fig. 3). Our standard assembly uses 2-inch fittings and hoses for all intake plumbing. We reduce discharge lines to 1 inch or ¾ inch for ease of use. There are variable flow 1-inch nozzles that can put out 10–30 gallons per minute, which is adequate for most situations. Reducing the fitting size on the intake side reduces maximum water flow on the discharge side.

Other important considerations:

1) Preconstructed skid-frames can be purchased for different prices (average price is approximately $800) or they can be self-constructed for much less. The main concern is will the skid-frame fit in the bed of your truck (between wheel wells and over a goose neck hitch), and will your truck handle the load. We suggest a skid-frame that can fit in almost any truck so it can be transferred easily.
2) Tanks can be plastic, fiberglass, or metal in any size. We use plastic because it is lighter and costs less. Prices range from about $150 and up for the 150+ gallon tanks.
3) Plumbing is usually kept as simple as possible. We like to include at least one fitting to allow drafting to refill the tank quickly. The best fittings are galvanized or aluminum because they are strong and do not rust. We also have used poly and nylon fittings. These work well when connected to flexible connections but sometimes do not hold up if they are used in a position where there is movement or vibration. We have developed systems that can draft water, transfer water, spray with a 1-inch line, a garden hose, or inject soap into the system.

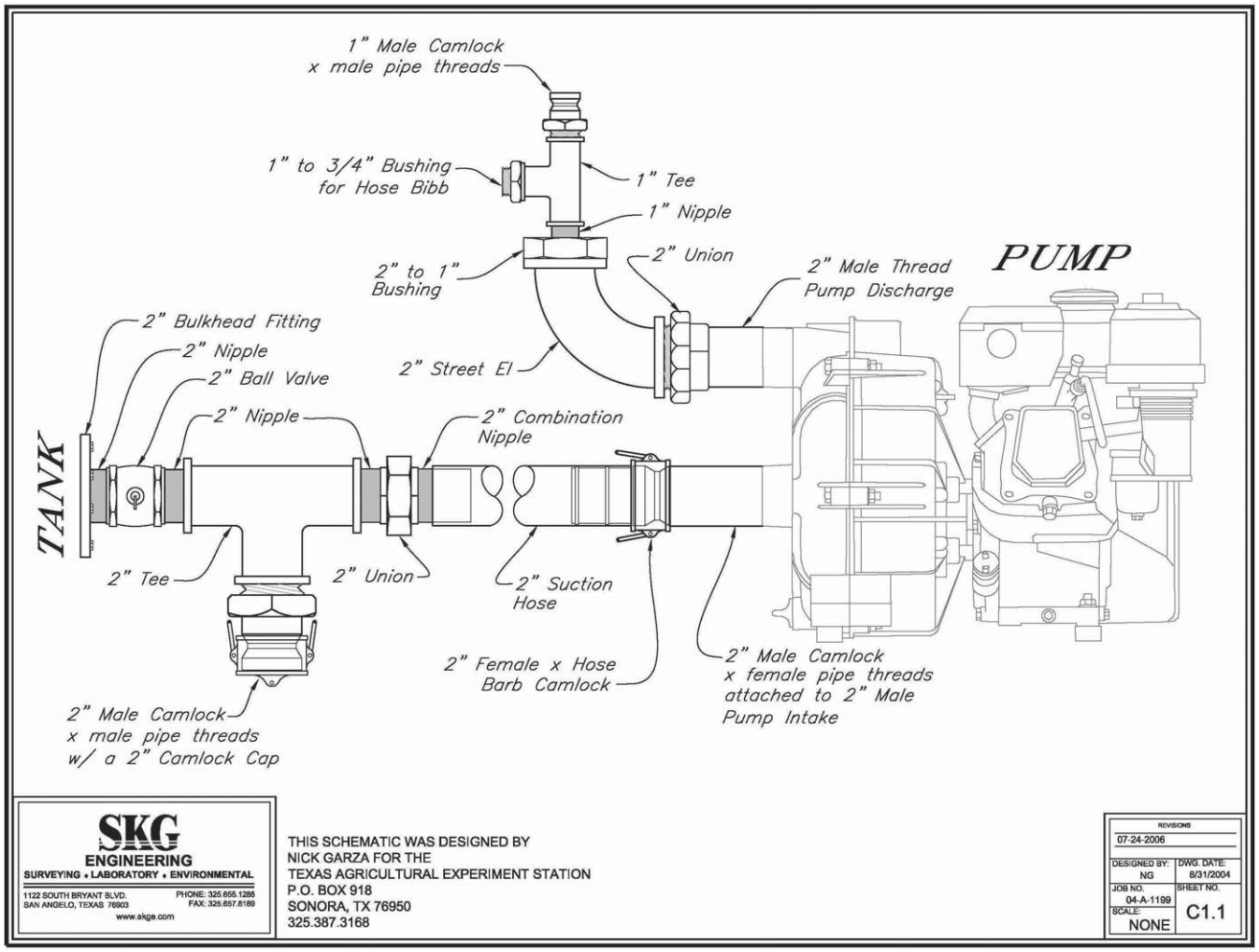


**Figure 3.** Schematic design of slip-in spray unit.

4) Use a 2-inch bulkhead fitting in the tank and mount the pump in a position to connect the 2-inch intake to the 2-inch hole in the tank. If you are not interested in being able to draft from a reservoir, then hook directly from tank to pump. If you want to draft, then connect a 2-inch T and a ball valve in between the pump and tank so you have a connection and a cutoff to stop the flow of water from the tank. A 2-inch male cam lock and a 2-inch cap is all that is needed to close this connection. The ball valve is open when spraying water and closed when drafting.
5) Fifteen to 20 feet of suction hose should be adequate for drafting. A strainer should be attached to the end of the hose to prevent the passage of solids greater than 1/8 inch in diameter.
6) We like to use approximately 20 to 30 feet of 1-inch red utility hose which does not need to be rated for high pressure. We prefer this length because hoses of greater length increase the probability of the hoses being tangled, run over, and in the way. Also, we prefer the operator to stay in the back of the truck as much as possible and not be lugging a fire hose any great distance from the truck. Use whatever kind of nozzle is preferred, but remember that volume is always going to be determined by the smallest opening on the line.

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## Reference

1. Taylor, C. A., Jr. 2005. Prescribed burning cooperatives: empowering and equipping ranchers to manage rangelands. *Rangelands*. 27:18–23.