This document contains examples and technical information for landowners who are interested in installing water developments.

Landowners who need technical assistance designing a water development can contact NRCS:
https://www.nrcs.usda.gov/wps/portal/nrcs/main/co/contact/local/

Water Development Project Evaluation Guide

To better evaluate your water development project please include detailed descriptions, drawings and maps that answer the questions in the critical phases of the development listed below.

Design References

What are the sources of the project design and specifications, such as publications and websites?

Need

Does development of this water source resolve an insufficient water supply for wildlife and /or livestock in a specific area, resolve a grazing distribution problem, or does it divert water to a better location for use by wildlife and/or livestock?

Show development location and other available water sources in the area on a map.

Source

Is the water source reliable and sufficient during the desired time of use?

Describe actual or estimate water production and the amount of water needed.

Trough Location

Will the trough be located where it is accessible , where it will not create unacceptable erosion, and where wetlands and riparian areas will not be impacted by livestock congregating.

Show the trough location by description, maps or photos.

Excavation

Does the water source and pipeline depth require excavating equipment, such as a backhoe; does the underlying rock formation or wet areas allow excavation; and is the area accessible to needed equipment?

Describe how you will mitigate or overcome obstacles to excavation.

Collection

How will the water be collected?

By description and/or drawings give a detailed plan of the collection system, including the type of materials used.

Delivery and Storage System

How will water be delivered to the point of use?

By description and/or drawings give a detailed plan of the water delivery system, including the type of materials used.

Trough/storage

What type of trough/storage will be used, how it will be plumbed and secured, and is there sufficient capacity to meet daily water demand?

By description and/or drawings give a detailed plan of the trough and any additional storage system, including the type of materials used, and explain how you determined the needed storage capacity.

Fencing and Revegetation

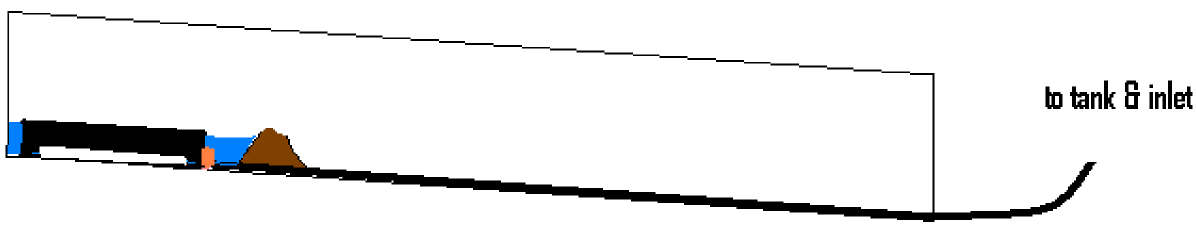
What reseeding and rehabilitation will be undertaken to restore areas disturbed during construction, and what fencing is necessary to protect development facilities, reseeding and adjacent sensitive areas?

General Steps for Collection of a Spring Source

1. **Identify area for underground water collection**. Topography, soil type, and rock/clay layers all influence where water is held underground. The underground water will generally be close to or just above the spot where the water surfaces (if it does). Look for clues in the vegetation to help identify where water is being accessed below. Potentilla (shrubby cinquefoil) will be present around the edges of a source, but usually not located above the source itself. Cinquefoil generally indicates a dry edge, drying trend, or transition area. Water-dependent grasses to look for are: tufted hairgrass (*Deschampsia*), riparian sedges (wetland *Carex* ssp.), rushes & wiregrass (*Juncus* - although they can persist in dry areas), bluejoint reedgrass (*Calamagrostis*), bulrushes (*Scirpus*), and spikerushes (*Eleocharis*). Another clue to good underground water sources are sites just above natural rock dykes.
2. Once the source area is identified, **mark the area you plan to dig**.
3. To **locate a tank spot**: walk down or across the drainage from the identified collection source in search of a dry, upland area free of trees/shrubs on which to place the tank. Be mindful of the line to be dug (trees/rocks/slopes). To measure for fall (gravity feed of the water to the tank), use of a survey transit is recommended. You need to be far enough downhill to daylight the water and then add at least 3 feet of vertical rise to get it into the tank. The depth of the ditch then will be added to this vertical height to account for water flow out of the ditch and into the tank – 8 to 10 feet is usually sufficient, but greater footage makes the job easier. There needs to be enough drop from the source to the tank to force water down the line. Mark the spot for the tank.
4. Before any digging begins, **lay out all of the pieces** needed for the collection: ½ sections of sewer infiltrators, connectors, perforated pipe, 1 ½" black poly pipe, poly connectors, clamps and some large rocks or end caps for the infiltrators. Make sure the poly pipe is uncoiled and straightened out as much as possible. (Sunny days help make the pipe more flexible, so uncoiling the pipe while you're doing other work makes it easier to maneuver.)
5. The backhoe (or similar) should be located on drier ground outside the wet area. **Begin digging at the source** in the shape of the infiltrator and continue until water is pooling in the hole.
6. **The hole must be dug large enough to accommodate the infiltrator**(s). The hole needs to be roughly the same size and shape as the infiltrator(s) you plan to use. If the source is sluggish and pooling minimal water, you may want to increase the number of infiltrators. If the source is producing lots of water only one infiltrator may be needed.
7. Once the collection area is ready, **lay in the perforated pipe**. Set the infiltrators over this pipe and connect the sections together if using more than one. Use several large rocks (or end caps) to block the ends of the infiltrators and hold the pipe in place to prevent sediment/debris from accumulating inside the infiltrator and drain.
8. **Build a small earthen dam** to hold water back in the main collection as you begin to dig the ditch for the line.
9. **Dig the ditch** in a horizontal arc on the outside (dry part) of the drainage. Do not dig down the drainage in the wet!! Keep the backhoe on dry ground. The trench can be brought around to the tank spot.
10. The key to a trouble-free spring development is **keeping the bottom of the ditch level** and even. The more bumps or waves in the bottom of the ditch, the more chance of airlocking the line.

11. Continue to **dig trench until the tank spot is reached**.
12. **Lay the first section of black poly pipe** in the trench and shove 1-2' of pipe into the perforated pipe alongside or under the earthen dam.
13. **Lay pipe in the ditch and make connections as needed**. Clamp connections tight. Allow water to flow through pipe. The end of the pipe can then be brought out of the ditch and held to a level that stops the flow.
14. **Proceed as normal for assembling the inflow, tank and outflow**. Make sure outflow is buried underground and that it gradually daylights and returns water to the drainage of origin.
15. Once everything is hooked up and functioning well (filling the tank), **the ditch can be filled** in. Nothing special needs to be laid over the collection. The filled ditch should be slightly higher than the surrounding land to account for settling.

Correct installation - smooth ditch, infiltrator, perforated pipe, rock, poly pipe and dam



Incorrect installation - airlocking humps, inefficient collection

Sewer Infiltrators (high capacity preferred)

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SPRING DEVELOPMENT

(No.)

CODE 574

DEFINITION

Collection of water from springs or seeps to provide for livestock and wildlife.

PURPOSE

Improve the quantity and/or quality of water for livestock and wildlife.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where a spring or seep will provide a dependable supply of suitable water for the planned use.

CRITERIA

General Criteria Applicable to All Purposes

Design the spring development based on site conditions, to collect sufficient water for the intended purpose of the development while protecting ecological functions of the site.

- Identify and evaluate alternative water sources before considering the development of a spring.
- Document the need for spring development in either a grazing or wildlife management plan.

Spring development for livestock water may cause adverse impacts to fish and wildlife habitat. Develop only as much water as is needed to facilitate prescribed grazing.

An investigation of the site conditions shall be made, including:

- Water quantity for the intended purpose
- Water quality for the intended purpose
- Suitability of the spring location for the intended purpose
- Soil and geologic suitability using soil borings or test pits
- Effects on existing ecological functions of the spring and potential losses from the development, including effects of the impoundment and/or diversion of spring water on local wildlife and wildlife habitat, and the effects of consumptive use on riparian health and function, stream flow, water temperature, and local aquifer recharge.
- Complete the Environmental Evaluation Worksheet (NRCS-CPA-52) wetland worksheet. If wetlands are affected, follow appropriate mitigation measures.
- If the site contains wetland, appropriate actions must be taken to avoid, minimize, or mitigate adverse impacts.
- Evaluate impacts to wetland function and value using Wildlife Habitat Evaluation Guides and/or functional assessment tools, where available.
- Design the spring development so that it is protected from damage by freezing, flooding, livestock, excess sediment, vehicular traffic and water quality contamination.
- An assessment of the cultural resource associated with the spring
- A determination that all necessary permissions to develop the spring have been or can be obtained prior to installation of the spring development, which may include but is not limited to:
  1) A Colorado spring or seep water right permit
  2) A Clean Water Act Section 404 Permit

3) Installation and maintenance easements

Source area. Design the spring development to preserve existing morphology of the spring as much as possible. Locate the collection site down slope of the point where the spring or seep emerges.

Exclude livestock from the source area.

Maintain fish and wildlife access to water from the spring development where applicable.

Develop the spring by removing obstructions to spring flow such as fine-grained sediments, rock, slope-wash materials and vegetation. Design the development of the spring to prevent obstructions from reoccurring.

Collection system. A collection system generally consists of tile, perforated pipe, or gravel collectors installed upstream of a cutoff wall. These collectors convey the spring flow to either a spring box or directly to a pipeline, which conveys the flow to the point of use.

The cutoff wall may be constructed of concrete, clay, masonry, plastic sheeting or sheet pile.

If the point of use is above the spring, base the type and size of the pump on available power sources and water delivery needs. The pump shall meet the criteria of Conservation Practice Standard 533, Pumping Plant.

Include measures as needed to prevent sediment from entering the collection system, and/or include a spring box to trap and remove accumulated sediment. A spring box may also be used to store water to meet peak water demands.

Spring box. Locate the spring box downhill from the source if possible. Protect the spring box from freezing by burying in the soil or other methods suitable for the site.

Size the spring box to provide sufficient storage of both sediment and any required water storage. Ensure that the cross-sectional area of the spring box is large enough to allow access for periodic cleaning. Use a minimum cross-sectional area of 1.5 ft^2.

Construct the spring box of a durable material such as concrete, rock, plastic, galvanized steel or wood that is untreated or rot resistant.

Provide the spring box with a tight fitting cover to prevent surface runoff, animals or trash from entering.

Locate the outlet pipe a minimum of 6 inches above the floor of the spring box to allow for sediment collection.

Outlet. Provide the spring development with a means to carry the water to its intended use. If a pipe is used, design the pipe according to Conservation Practice Standard 516, Livestock Pipeline. Alternative outlet structures shall meet the criteria of Conservation Practice Standard 587, Structure for Water Control.

Facilities intended to provide access to water from the developed spring shall be designed according to Conservation Practice Standard 614, Watering Facility.

Spring flow management. When flow from the spring, whether intermittent or continuous, will exceed the capacity of the collection system, an overflow is required. Size the overflow to carry the maximum flow expected from the spring. Locate the overflow so that it does not cause erosion, degrade water quality or create wet conditions near the watering facility.

To minimize potential adverse impacts to wetlands, one of the following measures should be implemented (listed in order of priority):

- Install a float valve on the tank/trough, if applicable, and leave all excess water in the spring.
- Direct overflow back as close to the source as possible to enhance existing wetlands.
- Create new wetland habitat that is capable of providing similar wetland functions as those being lost.

Smooth and grade areas disturbed by construction of the spring development as needed, to properly manage runoff from natural spring flow, collected water, and overflow.

Re-establish vegetation on disturbed areas after construction with native plant materials where possible. Where vegetation is difficult to re-establish, follow Conservation Practice Standard 342, Critical Area Planting.

CONSIDERATIONS

Springs often contain rare flora and fauna. Development should minimize disturbance to these species. Policy regarding impact to threatened, endangered, or special concern species must be followed.

A shutoff valve on the spring outlet pipe should be considered for winter shutdown, flow control and maintenance. Open pipe vents should be screened to prevent wildlife entrapment and potential water contamination.

Brush removal, excavation, clean-out and withdrawal of water are manipulations that may affect fish and wildlife habitat and wetland functions. However, selective removal of undesirable brush and management for desirable native plants may reduce evapotranspiration losses and conserve biodiversity.

Prior to construction, identify and control any undesirable plant species that may be spread by seed or vegetatively.

Consider how other conservation practices applied within the spring recharge area may increase infiltration of precipitation or snowmelt to augment spring flows.

To the degree possible, exclude livestock access to existing wet and constructed overflow areas to protect water quality and quantity.

Natural springs and seeps tended to attract prehistoric and historic settlements and activities, which correspondingly increases the likelihood that cultural resources are present in and around the spring.

PLANS AND SPECIFICATIONS

Plans and specifications shall provide details of planned location, materials and construction requirements for the installation of the practice to meet its intended purpose.

As a minimum the plans and specifications shall include:

- Location of the spring development
- Materials to be used including pipe diameter and class, collection system, etc.
- Elevations of pertinent components such as collection system, pipes, etc.

Certification documentation upon completion requires:

- Flow rate of developed source
- Type and diameter of pipe, and pressure rating
- Length of pipe
- Backfill class and material class (if applicable)
- Dimensions of collection box
- Conservation measures implemented

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) shall be provided to, and reviewed with, the landowner. The O&M plan shall contain a schedule for the periodic monitoring of the following items:

- Sediment buildup in the spring box
- Clogging of outlet and overflow pipes
- Diversion of surface water from the collection area and spring box
- Erosion from overflow pipes
- Rodent damage
- Vandalism and theft

Any problems discovered shall be immediately repaired. When cleaning out sediment from the spring box, place all sediments in the uplands away from the spring and associated wetlands.

REFERENCES

Heath, R.C., 1983, Basic Ground-water Hydrology: US Geological Survey Water Supply Paper 2220, 86 p., http://pubs.or.usgs.gov/publication/wsp2220.

Stevens, L.E., and Meretsky, V.J. 2008, Aridland Springs in North America - Ecology and Conservation: University of Arizona Press, Tucson, AZ, 432 p., http://www.uapress.arizona.edu/Books/bid1963.htm.

USDA- NRCS, 2011, Springs and Wells: National Engineering Handbook (210-NEH), Part 650- Engineering Field Handbook (EFH), Chapter 12, 24 p.

USDA-NRCS, Jan. 2010, Well Design and Spring Development: National Engineering Handbook (210-NEH), Part 631 – Geology, Chapter 32, 55 p.

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Step-by-Step Pictorial Guide for Spring Developments

This is where we identified the spring source for the collection.

The backhoe is situated just above the collection area on dry ground.

Water is starting to seep up into the ditch from underground.

The ditch is dug until it is large enough to accommodate the sewer infiltrator(s) and perforated pipe sections. These are then just placed in the ditch.

An end wall is placed on the end of the infiltrator up against the end of the ditch. Large rocks could be used instead, but the end wall makes it easy.

Rocks holding end wall in place.

Earthen dam constructed to hold water in the collection area.

Poly pipe has been placed inside the perforated pipe which is inside infiltrator. The poly pipe is under the earthen dam. Water will flow through it, so lift it up high enough so the water backs up.

The dam has a little breach in it so that as water fills the collection area, excess can drain off. Otherwise, there would eventually be so much water in the collection that no dam could hold it back.

Large rocks are holding down perforated pipe and poly pipe as well as blocking off end of infiltrator.

As ditch is dug away from collection site in an arc on dry ground, water from the breach in the dam fills the ditch. Poly pipe is laid in the bottom of the ditch as it is dug. Keep the bottom of the ditch **smooth**.

Note that this fill is dry, as it is being dug in an arc outside of the drainage.

Collection is over here…

As it becomes necessary to add more sections of poly pipe, use connectors and tighten with hose clamps. (Put the hose clamp on the pipe before connecting.)

Continue to dig the ditch in an arc on the outside of the drainage until you reach your intended tank site. You need to have enough fall to daylight the water and overcome vertical height needed to climb out of the ditch and up the side of the tank. Keep the floor of the ditch smooth and even to avoid air-locking the inlet.

The tank site can be leveled and completely set (including inlet and outlet assemblies and posts/planks) before even starting to dig the collection and ditch.

Hand-dig the last portion of the ditch to bring it up to surface grade where it meets the tank. This will ensure a solid surface for the poly pipe to rest against as it comes up. Bring the poly pipe up in a gentle curve without kinking it. Secure it to one of the tank posts.

Cautionary Note! Be careful any time you are working in a ditch as the sides can cave suddenly and with force.

Run 2" overflow in a ditch that will return the water to its original drainage. The overflow pipe should be at ground level where it actually returns to the drainage to avoid erosion.

Let the tank fill as you work on the overflow. Make sure everything is running well and that the flow is consistent and not coming in spurts. Water that shoots out in bursts or that stops altogether indicates airlocking.

It works best to place the inlet between planks for protection.

Cover the infiltrator directly with material pulled out of the collection ditch. Do this by hand at first. Once it is covered, the entire ditch can be filled in using the backhoe.

Cover the ditch leaving the dirt a little higher over the trench to account for settling.

Note how level the tank is by the way water sits in tank.

The disturbed areas of the ditch lines can be seeded with a native seed mix if desired.

Finished spring development the day after installation.

The same development one year later.

<u>Steps to Install Tire Tanks after Source is Collected</u>

1. **Pad for tank must be perfectly level** before the tank is set. Make sure pad is large enough to accommodate cattle – a small mound where lots of animals are congregating will erode in no time. Take time and effort with this step - it is very hard to make adjustments later.
2. **Ditch for overflow pipe should be dug by hand** from center of tank to 1 foot past downhill side of outer edge of where tank will be; this keeps pad solid for tank. Dig trench only as wide as overflow pipe. A pick ax works well for this job. (Never dig this trench with the backhoe – not even with a narrow bucket.) Ditch under the tank needs to be dug the right depth so the top of the overflow pipe will be the correct height. Measure height of tire and length of overflow pipe to get approximate depth of ditch. Do not install overflow pipe at this time.
3. **Put tank into position**; tank should be completely level. Check all directions for level.
4. **Dig remainder of overflow ditch with backhoe to get water away from tank**.
5. **Slide overflow pipe under tank** and into ditch dug by hand. Use insert fitting and 90° elbow to connect poly pipe to steel pipe. Check to see if overflow pipe is correct height; a transit or straight board across works to determine height. Overflow pipe should be 1 ½ to 2 inches below top of tank. Tamp dirt around overflow pipe and down under tank as far as possible, keeping overflow pipe straight up.
6. **Install inlet pipe from collection down inlet ditch**. Make a nice smooth bend from bottom of ditch to 15 inches above top of tank. Be sure not to kink the pipe; bend will be around 45°rather than 90°. (See figure 1).
7. **Set a post in the ditch next to the inlet pipe**. Pipe can be temporarily tied to post.
8. **Use a 90° insert fitting and short piece (about a foot) to turn water into tank**. Turn short pipe with natural curve pointed down. Do not clamp tight so pipe can be repositioned for water to run to outer edge of tank. You can now use this water to mix cement.
9. **Work on cement**. Premixed sacks of cement (like Sakrete) work best. Use about 15-20 - 80lb bags for an 8 foot tank or about 20-25 – 80lb bags for a 10 foot tank. (Depending on tank and height of bead, it may take more or less.)
10. **Cement can be mixed in center of tank**. Empty first bag in center of tank; use hoe to splash water over bead to mix. After several bags have been mixed, push cement under tire. (You can also push a little dirt under the tire first to help seal the cement in and limit the amount of cement used.) Continue to mix sacks in until cement is to top of bead.
11. **Make sure overflow pipe is straight up**.
12. **After water has covered cement, inlet pipe can be turned toward center of tank and clamped tight**. Water will completely cover cement, allowing the cement to cure slowly.
13. **Build a protective box around post to protect inlet** so cows can't turn pipe out of tank. (See Figure 2). Other options may work as well.
14. **Tie inlet pipe to post** with heavy gauge wire.

**Putting inlet pipe 15 inches above top of tank requires having enough fall from spring source. Tank may have to be moved down hill to create enough fall. If replacing an old tank, the ground around the old tank may be in a depression. It is best to put the new tire tank on fresh, solid ground. A large gravel apron built up to the sides of the tank works well to combat erosion. Check tank frequently once livestock start using it to make sure everything is working well. Stay up on maintenance. Unchecked erosion can destroy a quality job. A clogged overflow is usually the culprit. Make sure the overflow remains clear – it may be necessary to install a sleeve or an elbow to keep debris out of the pipe.*

Figure 1:

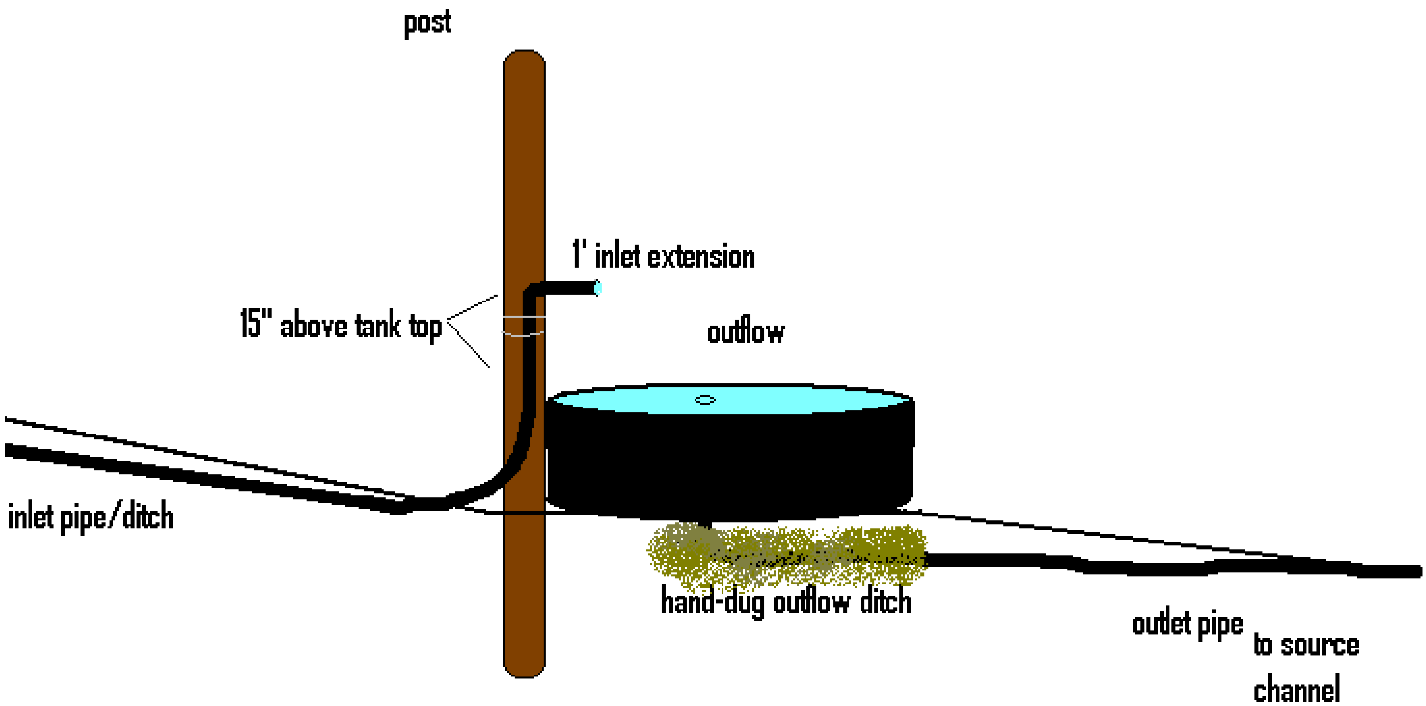
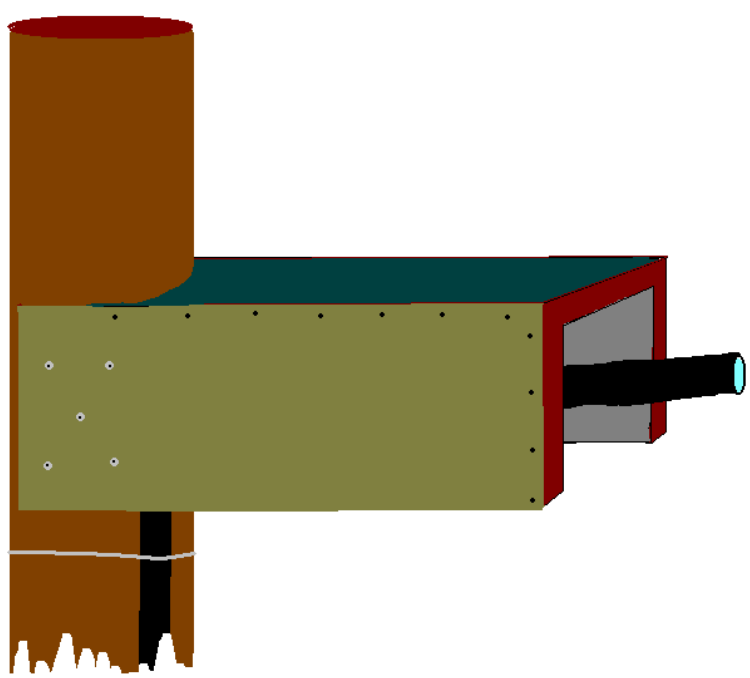


Figure 2:



Several examples showing quality work in a variety of environments and situations. Each spring is unique and presents its own set of challenges.