PART THREE

Building a Great Trail

The largest growing demographic for OHV recreation is people over 50 years of age.

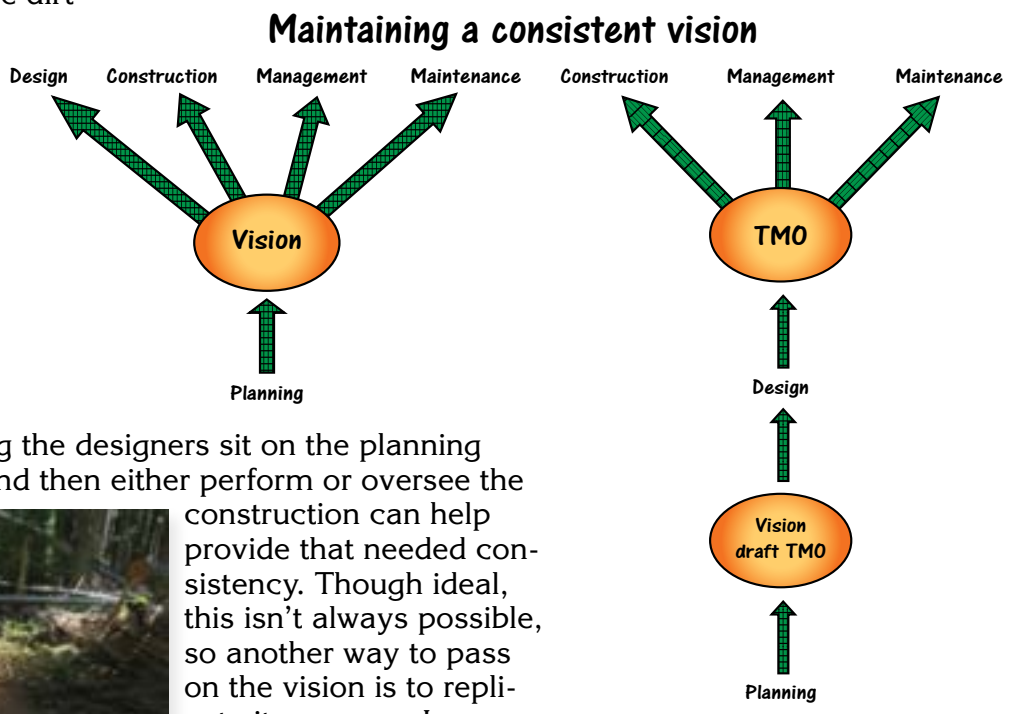
Chapter Sixteen
Construction

The Past is Not the Future

Construction is a time of excitement. But take time to get it set up before turning dirt.

A plan and a design have been created with care. With construction, the vision becomes a reality. For the designers, after days, weeks, or months of scouting and flagging, there is nothing more gratifying than seeing the flagline become a trail and to finally ride it. It is a WOW feeling and hopefully a WOW experience. Construction is an anticipated time and one of excitement. Everyone on the project team becomes rejuvenated with the smell of freshly turned dirt, the clanging of tools, and the sound of equipment as a trail becomes inscribed on the landscape.

This is a great moment in creating a great trail, but what happens after that moment may not be so great. There can be pitfalls; and when the vision in the project team's mind doesn't match the product on the ground, there are problems. Keeping construction flowing smoothly and avoiding potential problems starts before the dirt is turned in a process called preconstruction. Certainly one of the challenges throughout the continuum is maintaining a consistent vision: passing the torch from one component to the next. The obvious way to meet this challenge is to reduce the number of times the torch gets passed. Having the designers sit on the planning team, design the trails, and then either perform or oversee the construction can help provide that needed consistency. Though ideal, this isn't always possible, so another way to pass on the vision is to replicate it on paper. In preconstruction, maps, drawings, and specifications are written and assembled so that someone potentially unfamiliar with the project and the project area can look at the material and build the desired product on the ground. The process of transferring the vision is not an easy one, so investing time in developing a comprehensive construction packet can facilitate a smooth and complete flow of information and result in a great trail on the ground.



This is a new trail that was ridden in. The lack of a constructed tread has resulted in deep ruts created by compaction and displacement.

Section 1: Preconstruction

Determine Construction Option

One of the first tasks is to determine how the trails will be constructed, or even if they will be constructed. Whether a trail will be constructed by hand or machine-built has usually already been determined in the design and outlined in the final TMO.

Determine Construction Method

Once the decision has been made to construct the trails, there are four basic methods to accomplish that goal: force account, volunteers and groups, contract, and hybrid contract.

The **force account method** is when the agency performs the work with its own personnel and equipment. The agency must have skilled personnel and enough of them to efficiently perform the work. The other key ingredient is having the proper size and types of equipment to accomplish the construction tasks.

A crew of volunteers gets ready to work on trail maintenance

With the **volunteers and groups method**, a local club or organization takes on the construction of the project. Volunteer labor is often used as match dollars in grants, and many grantors require or will score an application higher if there is a volunteer component. There are also agencies and associations (like the Student Conservation Association) that have organized trail crews available for hire. With both of these, having skilled personnel, experienced supervision, and the proper equipment is essential.

The **contract method** is the most common option. A solicitation is prepared to hire a contractor to perform all or most of the work.

A **hybrid contract** is where the vendor is required to utilize and train volunteers to accomplish portions of the work. Though maybe not the most efficient, this method is popular because local enthusiasts receive necessary trail training that they can use later on for maintenance or implementation of another project. As with the volunteers and groups method, the volunteer component provides contributed funding, or match dollars, for grants.

Armed with a variety of tools, this paid crew from a local village is ready for construction.

The Preconstruction Packet

The construction method selected will determine the scope and complexity of the documents needed for the preconstruction packet. One of the documents that forms the foundation for all of the other preconstruction data is the trail management objective (TMO). Drafted after developing the concept plan and finalized after location and design, the TMO provides key information that triggers guidelines and parameters for design, construction, and maintenance. The TMO guides whether a rock gets taken out for a smooth tread or left as a technical feature. The TMO must be treated as a guideline and adjusted for regional and actual site conditions (there are too many variables with any trail to have a one-size-fits-all set of parameters). It shouldn't be used as an agency-wide standardized document. It is intended to be trail specific. Construction drawings and specifications are then drafted to convey the desired output to whoever is performing the work.

Pitfalls

If the packet is complete and well written, the vision can be adequately transferred to the contractor, but that doesn't always happen. Here's why:

Pinnacle Peak TR #801	
Trail Log	
Mile Post	**Description**
0.00	Begin construction at Pinnacle Peak trailhead. Install entrance management barriers and signing as per typical section EM1.
0.05	Install 18"x14' dual wall plastic culvert with headwall.
0.65	Construct armored rolling dip + lead-off ditch right.
0.86	Choke tread width down to fit between the two boulders. Do not disturb the boulders.
0.91	Cut danger tree 25' on left.
1.01	Construct turnout right.
1.22	Begin 6" compacted trail hardening rock.
1.29	End trail hardening rock.
1.35	Junction with TR#802 right. Construct T junction as per typical section JCT2.
1.41	Entering rock garden for 35'. Track equipment over this section and do not excavate rocks.
1.48	Outslope grade sag to drain left. Construct sump as staked.
1.52	Construct turnout left.
1.59	Do not disturb rock step-up. Construct easy-out on left as staked.
1.73	Junction with Road 2315-650. End construction.

A trail log is one useful piece of information for the preconstruction packet. More information is available at greatohvtrails.com

Lack of training. In general, it appears that there is a lack of training on preparing and administering an effective trail contract. In some cases, it has also become a very complicated and time-consuming process. Because of this, some agencies tend to avoid contracts or submit poorly crafted contracts.

Inadequate contract time. Often it takes longer than anticipated for agencies to prepare the contract, but still have a drop-dead date to expend grant funds and that results in a short contract performance time. A short contract time reduces the pool of available contractors and increases costs because the contractor loses flexibility to schedule this work with other projects or is forced to perform when weather or soil conditions may not be ideal.

Missing, incomplete, or inconsistent documents. If the agency doesn't have the time or the skills to craft a good contract, there can be errors. This leads to contract delays, perhaps change orders, and increased administration and contract costs. It takes time for a contractor to submit a bid. If the work to be performed is unclear, the bid cost will likely go up.

Using inapplicable terms or specifications. Using non-OHV terms like "freeride" or "coasters" indicates to a contractor that the agency really doesn't understand what it is doing or what it wants. This could increase bid costs. Because they are considered the standard, some contracts have requirements for tread outslope, the 50 percent rule, and the 10 percent average grade rule. Agency personnel should ensure that the terms used will provide the product they want before they automatically insert those terms into an OHV contract.

Inadequate cost estimate. Contracts often get cancelled when the bids exceed the agency's estimate. This adds time and cost to the whole contracting process and may delay the implementation of the project. Someone knowledgeable in trails, structures, equipment, and the sequencing and performance of trail construction should prepare cost estimates.

Cookie-cutter contracts. To save time or due to lack of training, cut-and-paste contracts are prepared, but no two projects are identical. The agency can individualize a project and transfer the vision in the supplemental contract clauses, special project specifications, project-specific drawings, and the trail log, but these typically receive the least attention in a cookie-cutter contract. These types of contracts can create poor communication, which can result in a higher bid cost, higher contract administration costs, and a product on the ground that may not be the desired product.

The cheapest isn't necessarily the best. There may be someone locally who is enthusiastic and inexpensive, but does just anyone with a skid loader understand the intricacies of trails and have the proper equipment to build a great trail? If the work goes out for bid, many agencies are required to accept the lowest bidder. The reason to have well-written specifications and drawings

is to make it clear to all what the intent is and what constitutes an acceptable product. That helps put all bidders on the same page and helps narrow the range of bids.

If the agency does not require accepting the lowest bid, it is very important to clearly describe how the bids will be evaluated. These criteria can be very specific, right down to the type (not brand) of equipment and its capabilities, experience in relevant motorized trail work, level of operator skills and training, etc. Spending time crafting the Evaluation of Quotes will provide flexibility in selecting the best bidder.

Evaluation Criteria	
1.	Experience in performing mechanical OHV trail construction and reconstruction.
2.	Experience in operating a trail dozer with a blade of 48" or less. Operators must have 2000 hours minimum operating time.
3.	Demonstrate experience in operating in a variety of soil types and topography.
4.	Demonstrate understanding of the physical characterisitics necessary for a motorized trail to be rideable while protecting surrounding resources. These characterisitics include design (difficulty level, user needs, safety); engineering (inslope, outslope, tangents, circular curves, superelevation, drainage, "rideable flow"); resource protection (conserving soil, maintaining aesthetics, protecting vegetation, using care and discretion when parking or turning equipment, protecting sensitive plant populations and cultural resources).
5.	Actual OHV riding experience of the contractor and/or employee. (Riders generally have a better understanding of the items in #4.)
6.	Ability to follow and perform scheduled preventative maintenance on a trail dozer.
7.	Ability to recognize mechanical issues before they become mechanical breakdowns.
8.	Ability to train others in trail dozer operations.
9.	Member of the Professional Trailbuilders Association.

Section 2: Construction

The Construction Process

"Construction" means moving dirt and includes new trail construction, existing trail reconstruction, or trail relocation. Regardless of who does the construction, the nine-step process is, or should be, the same.

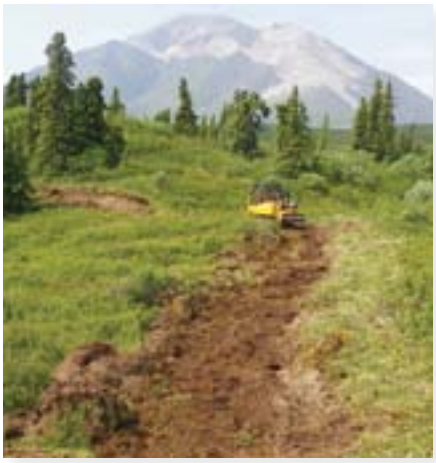
In remote areas, campsites for the crew are often required. These must be designated and approved in the preconstruction process.

Sometimes sizable areas are needed for staging equipment and materials.

Working ahead of the trail dozer, this crew has cleared the trees and heavy brush.

The dozer is removing the organic layer of vegetation and grubbing stumps. Note the high-cut stump for increased visibility and leverage.

An excavator is a good tool for grubbing and slash disposal because it can pluck stumps, scatter material without damaging other vegetation, and strategically place material to help control use.



This trail has been cleared and grubbed. Rough access is being pioneered in.

1. **Mobilization.** This is the movement of personnel, equipment, and materials to the job site. In remote areas, this can involve the establishment of base camps. Depending on the site location and complexity of the work, mobilization can be a substantial and costly task.

In most cases, access and work by heavy equipment must be sequenced and completed before the final trail prism can be shaped.

Once pioneered, the next passes build the cuts and fills to shape the trail prism and establish grade.

2. **Clearing.** This is the cutting of trees and heavy brush within the trail corridor (normally top of the cut to toe of the fill).

3. **Grubbing.** This is the removal of stumps and their roots.

4. **Slash disposal.** This entails the removal of all woody material from within the trail corridor.

The slope board and sheepsfoot roller are good finish grading tools.

A 37" wide mini-excavator constructs a single track trail and it looks wide and rough.

5. **Pioneering.** The next step is to rough in a tread or create a bench for the equipment to work on.

6. **Structures.** Unless there is other access, work on non-tread structures like bridges, culverts, and retaining walls as soon as there is adequate access to get materials, personnel, and equipment into the site. Depending on the terrain, this could start as soon as the pioneering is completed. Other structures like rolling dips, ditches, and sumps occur during excavation and embankment since excavated structures are usually used as a source of borrow material to help raise the grade of the trail tread.

Once riders have established a line, vegetation quickly re-establishes itself in the uncompacted portion and the trail now has a nice 18" natural-appearing tread.

7. **Excavation and embankment.** This is the process of establishing the grade and the desired trail prism. Cuts are excavated and fills or embankments are constructed.

8. **Finish grading.** Often referred to as the last pass, this is the final shaping and compacting of the trail tread and any related tread structures. This work must be consistent with the TMO and trail log.

The lack of pruning in the finish work has created poor sight distance at this trail junction. The ATV (arrow) is barely visible. The close decal spacing on the junction marker makes the numbers harder to read.

9. **Finish work.** This is all of the work that "makes it look pretty."

It includes:
- Final shaping and smoothing of cut and fill slopes;
- Pruning and lopping of roots protruding from the tread or cut slope;
- Installation of signing, cattle guards, fences, and gates;
- Constructing headwalls;
- Obliterating stockpiles, and equipment storage areas, staging and camping areas;
- Removing damaged vegetation;
- Closing undesignated areas;
- Final scattering of slash;
- Removing all flagging, stakes, or other construction controls;
- Seeding or replacing forest litter on all disturbed soil areas.

A new trail always looks rough and wide for the first year after construction. There has often been a lot of disturbance and it takes time for those impacts to heal. Once vegetation starts to re-establish and the unused portions of the trail tread and site get covered with forest litter, the trail will quickly appear to be narrower and more natural. However, this will only occur if the trail has been located, designed, and constructed properly.

Note: Though the process is the same for most trails, the sequencing of the process may not be the same due to the vegetation, topography, or complexity of the project. On many machine-built trails, grubbing, slash disposal, and pioneering occur simultaneously.

Management

No matter how the work is performed, there is a need for some level of construction oversight and project management. The agency usually provides this management, and the designers help to carry the project vision through construction. This work can also be outsourced to a contractor. Construction management includes project coordination, compliance inspection, documentation and reporting, information sharing, recognizing and avoiding pitfalls, and recognizing the need for change.

The project manager meets with a stakeholder to discuss maintenance of a road used by both parties. Meetings like this help foster relationships that are based on open communication and trust.

Project coordination. This can involve a multitude of tasks, including ensuring that materials and supplies are ordered and delivered so that the work can proceed in a timely fashion; sequencing the work so it flows smoothly and logically; scheduling, coordinating, and overseeing volunteer work parties or other trail crew work; ensuring that any required permits are secured; scheduling any required resource surveys; ensuring conformance with any seasonal work restrictions; meeting with stakeholders to

discuss issues or concerns; ensuring that construction controls are in place or replacing any that are missing or damaged; renting or repairing equipment; and purchasing any necessary tools or supplies that are needed by the work crews.

Compliance inspection. Regular inspections help keep the projects running smoothly.

The inspector:
- Ensures the specifications are adequate to produce the envisioned product.
- Ensures the work meets the intent and project specifications.
- Coordinates necessary parties to resolve any discrepancies between the product and the specifications.
- Ensures workers are in compliance with any required safety certifications.
- Strives to increase safety awareness, conducts safety briefings, and discusses job hazard analyses (JHAs).
- Observes the work and discusses any unsafe practices or conditions.
- Ensures compliance with any required work shutdowns for fire, wildlife, weather, etc.

Documentation and reporting. There is a saying "If it isn't in writing, it didn't happen". Document the progress and quality of the work, preferably on a daily basis. Take photographs. There can never be enough photos. It may be several months later before the team discovers that it needed documentation regarding events on a particular day. Ensure that volunteer records or records of any other personnel, materials, or equipment that is used as match for grants are kept.

Information sharing. Everyone likes to be in the know, and some parties need to know what is happening with the project. Use photos to prepare regular project updates for management, advisory committees, grantors, stakeholders, or the media. Photos are a great tool to document the progress of the project, increase project awareness, and increase political and public support for the project or agency.

Recognizing and avoiding pitfalls. Experienced trail project managers know how the work should be performed and when it should be performed. When something is out of sync or is heading in the wrong direction, taking immediate action to discover the cause can avert downtime, accidents, or other delays in the work progress or quality.

Trail construction is fun and rewarding because the team can see the trail take shape on the ground, but it can also have inherent hazards and risks. It is important to take appropriate action to minimize those hazards and mitigate the risks. This is especially important for equipment operations. Workers need to be trained in how to safely approach and how far to stay back from working equipment.

The operator is looking down to see what might stop him if something happens on steep ground. With loose soils, a spotter needs to be on-site.

There are times when equipment can be working in precarious locations. Some agencies require spotters or equipment safety personnel to be on site any time the equipment is working, but certainly when the risk is high, a spotter should be on site as should the project manager.

The project managers also need to be aware of the resource concerns and values in the project area and to take appropriate action when those are encountered. It is not uncommon to suddenly see an unusual population of plants; discover a TES nest or den; or unearth a bone, tooth, or arrowhead. Someone needs to be watchful in these situations because there are often legal protection requirements and what happens next can delay or stop the project altogether. Being forthright about any discoveries can build trust and credibility with resource specialists.

Recognizing the need for change. Implementation is the last chance to get it right. In spite of all of the concerted efforts in planning, design, and preconstruction, sometimes the intent just doesn't fit the ground as anticipated. The project managers need to be on the alert for these situations so changes can be made early before large amounts of time, money, or materials are invested.

Pitfalls

Weather delays. Either extremely dry or wet weather can preclude effective or safe trail construction or even access to the project site. If contract time is inadequate to accommodate these delays, a contract modification may be required that could delay construction or increase costs.

Material delivery delays. Sequencing, poor project management, or inclement weather can delay the delivery of materials and supplies. Depending on the amount of other types of work to be performed, this could delay or stop the construction progress. If the agency was responsible for providing these materials, a delivery delay could result in a claim and increased contract costs.

Any delay in material delivery, project sequencing, or weather could impede the completion of this major structure and perhaps other trail or project work.

This chicane was not designed. It was created by the equipment operator who wanted to make the trail more challenging. This should not be done.

The trail was designed (flagline) to go up a rock step-up which would have been consistent with other features on this trail, but the builder chose to avoid it by moving off to the right and putting in a 90 degree turn above the tree. The result is a loss of a challenge feature, tread durability, and flow.

Tip, Trick or Trap?

Tip: Great trail construction isn't about how much dirt you move, it's about how much dirt you conserve

Creative license. There are times when the flagline needs to be changed, but there are also times when the crew leader or equipment operator takes creative license and arbitrarily changes the design. Unless the crew leader or operator is also the project designer, this is inappropriate. If the trail has been properly designed, there has been a thought process involving analysis and informed decisions for the location of every flag and every aspect of the design. But the worker may not know, understand, or agree with those decisions. Any changes should be discussed with and approved by the designer or project management.

Failure to adhere to specifications on a complex trail like this can result in structure failure, resource impacts, and the loss of a considerable investment.

Unskilled operators. Equipment operators can make or break a project and make the construction process a joy or a hassle. They can take a great trail design and build a poor trail or take a poor trail design and create a great trail.

Inexperienced work crews or contractors. When it comes to trail construction, there is no replacement for experience. Trails can be intricate and require a great deal of innovation, field design, and finesse. Having someone who knows what to do, when to do it, how to do it, and how to appropriately adjust it for the site is invaluable. No matter how good the drawings and specifications are, they can't teach someone how to do the work. A local crew may be inexpensive, but if they're inexperienced and make mistakes, the long-term costs of maintenance, repair, or replacement can far outweigh the initial construction savings. Comprehensive specs and drawings along with a well-written evaluation of quotes may help ensure an experienced contractor and a quality product.

The deeper the cut, the higher the likelihood of encountering solid rock. Having air tool capabilities makes this less of an obstacle.

Inadequate oversight or contract administration. It doesn't do any good to prepare a thorough preconstruction packet if that packet isn't effectively administered in construction. Inexperienced oversight and inspection can lead to as many problems as inexperienced workers or operators. Unskilled oversight, infrequent site presence, unfamiliarity with the process or the end product, or permissive inspection that allows non-conformance with the specifications can all lead to poor agency-contractor relations, claims, and a substandard product. It can be difficult to confront someone when the product or procedure is not meeting a specification, but a contract is a legal and binding document for both the agency and the contractor. Both parties are at risk of claims when there is non-compliance with the specifications. The contract administrator manages that risk.

Equipment down time is project down time. The project manager and operator discuss the source of and remedy for a hydraulic leak.

Inadequate documentation. When something goes wrong, there is an immediate need to find out why it went wrong. It takes time and effort. There can never be enough photos, and daily diaries can never be too thorough.

Preconstruction errors. Preconstruction is the communication bridge between design and construction. No matter who performs the construction, shortcuts taken in the preconstruction process can become very evident and costly in the construction process.

Unanticipated site conditions. Any time excavation is involved, there is a chance of encountering any condition that was not evident from surface investigation. This can result in a design change, contract modification, lost time, and lost progress on the project. This risk can be minimized by digging at least cursory test holes during the design process. Any subsurface information should be outlined in the preconstruction documents. Bid costs will likely rise when excavation is required and subsurface information is nebulous.

Equipment breakdowns. With equipment, the question is not if, but when, there will be a breakdown. They rarely occur at an opportune time or location. No one can afford to have back-up equipment or a warehouse full of parts on site, so equipment downtime can mean project downtime unless there are other types of work to be performed.

Accidents. Trail construction has hazards and risks, but certainly a nightmare for any project is to have a vehicle, equipment, or personnel accident. Regardless of fault, everyone loses when an accident happens. Lost time, lost money, personal injury, workmen's compensation, an investigation, or a damage claim can result; it's all ugly and uncomfortable. Projects and OHV programs have collapsed due to accidents. Work diligently to manage the risk.

Change Construction Method. How a trail is to be constructed affects how the trail is located. A hand-built trail is not located the same as a machine-built trail. It can be a mistake to take a trail that was intended to be machine-built and build it by hand. A hand crew will take the path of least resistance and go around trees, stumps, and rocks. This will alter the designed flow of the trail and possibly the drainage. Likewise, a trail that was designed for hand-build may squeeze between features or go over terrain that a machine cannot traverse. If the construction method is going to be changed, take the time to adjust the flagline first.

Great trails are created through planning, design and construction. Great trails are kept through great maintenance and management.

Post-construction Management

A trail is most susceptible to the forces of compaction, displacement, and erosion during the first year after construction. Protect the investment. Consider closing the trail immediately after construction and let it sit over the winter or whenever the wet season occurs. Sometimes demand and political pressures are so high that this option is not practical, so consider closing the trail until there have been a couple of wet weather events. These options are especially important if the trail has been constructed during the dry season and the tread and embankments are unconsolidated. The weather will help provide natural compaction and cohesion.

A speed event was conducted on this trail shortly after it was constructed. The result: deep ruts and failure of designed drainage. Weather events will help consolidate a new trail tread, premature speed events can destroy it.

If possible, the first use on a trail should be light and low impact so displacement is minimized and compaction can occur slowly and evenly over the whole tread surface. Severe impacts can occur if an event is scheduled during that first year. With most soil types, a newly constructed trail cannot sustain a high volume of use in a short period of time.

Don't schedule a speed event within the first year of constructing a trail.

A Closer Look...

There is a perception that since trails have a small footprint, they are simple: anyone can design one and anyone can build one. That misconception has resulted in poor riding experiences, erosion, visual scars, resource impacts, and ultimately closures. Though riders or the motorized use are often blamed for these impacts, it was the poor location, design, and construction that created them. With a closure, riders lose recreation opportunities which often are not replaced. What isn't often recognized is that a closure represents a failure by the agency to effectively provide for and manage the use. One of the purposes of this book is to help agencies avoid that situation by giving them the tools to create great trails, either by building new ones or fixing old ones. A great trail is a success story. It's a win-win for the environment, the agency, and the riders. We can achieve that success only by the effective and equal implementation of all five components of the Great Trail Continuum.

Need more? Learn more here...

Trail Construction and Maintenance Notebook, USDA Forest Service, Technology & Development Program, 0723-2806-MTDC, July 2007

Standard Specifications for Construction of Trails and Trail Bridges on Forest Service Projects, National Technology and Development Program, October 2014; http://www.fs.fed.us/recreation/programs/trail-management/trailplans/

A Look Back...

Here are some of the elements discussed in this chapter:

- Preconstruction is the bridge between planning, design, and construction
- Preparing a detailed, comprehensive preconstruction packet will help carry the vision forward into construction, facilitate the construction process, and help ensure a quality product
- The supplemental contract clauses, special project specifications, project-specific drawings, and the trail log are the key places to individualize the project and transfer important information to a contractor
- Recognize the common preconstruction pitfalls and invest the time and effort required to avoid them
- The construction process is essentially the same for every project: mobilization, clearing, grubbing, slash disposal, pioneering, structures, excavation and embankment, finish grading, and finish work
- Whether performed by the agency or contractor, good construction management and contract administration are essential to ensure proper sequencing of the work, quality control, conformance with specifications, and coordination and communication between the agency, stakeholders, and the contractor
- Good post-construction management of the trail by temporarily closing or limiting use will help protect the integrity of the new trail and facilitate the re-establishment of vegetation