RESULTS OF INNOVATIVE CONTRACTING AND RECLAMATION METHODS USED FOR THE FONDAWAY CANYON MINE CLOSURE PROJECT, FALLON, NEVADA[1]

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Abstract: This presentation provides an overview of the contracting and implementation processes used to close and reclaim the inactive Fondaway Canyon Mine. The closure and reclamation of the Fondaway Canyon Mine is now considered the "standard of reclamation" by the BLM in Nevada. The mine is located approximately 40 miles northeast of Fallon, Nevada on the western flank of the Stillwater Mountain Range. The site is subject to mining claims held by EPEC Minerals Company–Nevada, a subsidiary of El Paso Corporation, and has been inactive for over 10 years. The project was a medium-scale open-cut and underground gold and silver mining operation, with a heap leach pad and Merrill-Crow recovery plant. Golder's scope was to identify current methods for the closure of all facilities, negotiate appropriate changes to the existing reclamation plan and permit, develop construction level designs, conduct a bidding process, and oversee the implementation of the reclamation plan. Golder developed innovative reclamation and erosion and sediment control methodologies for each mine disturbance feature, but they also developed an innovative incentive based contract to be used to align the Contractor's goals with the owner's in the hopes of achieving a better and less costly end product. This paper documents and analyzes the effectiveness of the approach taken for completion of the project. The project was nominated for an excellence in reclamation award by the State of Nevada, Department of Environmental Protection.

Additional Key Words: Heap leach facility, draindown, solutions, incentive based contract

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Introduction

Have you ever had a project where the designer was fresh out of school and lacked the real world experience necessary to comply with today's tough reclamation and erosion control requirements? Or, alternatively, a project where the design was good but the contractor didn't understand it well enough to know which details to sweat and which to ignore, ultimately costing thousands more than necessary to complete the work? On many projects where these types of issues occur, numerous smaller issues also arise, such as unresolved change orders, expenses, or specification changes, that can take a great deal of effort to resolve. These types of scenarios are common to construction projects, and if you have been in this business for awhile, it is almost certain that you have encountered one or more of them. Typically, they are resolved by finger pointing, blaming, negotiating, and sometimes by bringing in mediators and attorneys at great cost. Collectively having been involved with construction management projects for over 55 years, the authors of this paper recognize that all parties have valuable unique knowledge, skills and talents to bring to the project, and, were determined to find a way of avoiding all of these common issues in order to increase the quality of the finished project and lower the stress level on the job site. The following sections describe how an innovative "incentive based" contract was used to align the designer's, contractor's and owner's goals and objectives so that all parties' focus would be the same, thus making communications, design and implementation of the design on-site much easier.

Project Description and Background

The Fondaway Canyon Mine is located on the west side of the Stillwater Range, approximately 36 miles northeast of Fallon, Nevada. The mine site was transferred to the current owners, EPEC Minerals Company - Nevada (El Paso), during a merger with Tenneco, Inc. in 1996. The site, while in operation, consisted of a main operations area referred to as the South Mouth Area, and another mining and exploration area farther up Fondaway Canyon. During its operating life, the South Mouth Area had several mining cuts (small open pits), several waste rock dumps, a cyanide heap leach pad and associated pregnant and barren ponds, a processing plant, an office complex, and associated haul and access roads. The Fondaway Canyon Area had an exploration adit, two mine cuts, and numerous exploration drill holes with associated access roads.

South Waste Rock Dump
Plant Growth Medium,
Mulch, and
Ripped Surface under construction

The site had been inactive since 1990, prior to the merger, and site closure and reclamation responsibility had been assumed by two third-party un-patented lode claims owners. The State of Nevada had been pushing for site closure and reclamation with little success. Due to the potential liabilities of a site with a past use of cyanide leaching agents, and understanding that a

legal battle to force the two un-patented lode claims owners to reclaim the site would be more costly than the closure itself, El Paso undertook responsibility and closed the site

El Paso worked with the agencies to update and gain re-approval of the original reclamation plan, and used that plan to close the site. The main issues related to closure and reclamation included re-grading the site to approximate original contours, installing surface water drainage control, and stabilizing the disturbed soils to prevent erosion. Because the site is located in extremely steep terrain, with over 18 miles of roads to reclaim and about 40 acres of other disturbed area, this task required a significant effort. Challenges in closure design also included addressing continued draindown of rinse solutions within the heap, and determining the best closure method for the Half Moon exploration adit. The draindown solutions were captured within a dosing tank and periodically discharged through a buried drip line on-site until draindown ceased. The system, which is basically a maintenance-free modified septic tank and leach field system, was approved by the agencies and is also in use on several other similar mines in Nevada. The adit was closed by placing a clay barrier berm to prevent drainage from exiting, and subsequently backfilling the entrance with waste rock from the initial excavation. Following closure, draindown water quality and quantity monitoring and observations for seepage from the Half Moon adit were required semi-annually for approximately three years following closure.

South Waste Rock Dump after completion

All reclamation activities are now complete, and the site has passed through post-closure status to final bond release. As a stipulation of bond release, erosion and vegetation performance monitoring were required for a minimum of three years at which time requests for final inspection and remaining bond release were made. All areas of the site successfully passed inspection and achieved bond release in 2002, with the exception of the heap leach pad area, which was ripped, mulched, and reseeded in 2001, and ripped and reseeded again in 2002. In July 2003, this area was inspected, and in August 2003 a request for final bond release was submitted. The reclamation bond was released this past fall 2004, after the agencies determined that revegetation had been successful and all remaining items at the site had been addressed.

Contracting Issues

Mine reclamation projects are typically completed either under lump sum or time-and-materials-not-to-exceed contracts. An Owner's representative and an engineering design firm's representative (QA Reps) are generally on-site throughout the project to observe construction, to ensure compliance with the specifications, and to provide quick response to any questions that arise regarding the specifications. In some cases, as on this project, the engineering design firm's representative also functions as the owner's representative. Issues often arise where tasks cannot be completed as designed because the designer had insufficient information prior to beginning field work, or new information is obtained during the field work that changes the

design parameters. These situations typically result in a need for quick re-design, change orders, and sometimes contract changes and negotiations. Any difficulties in these processes can quickly bring a project to a stop until all parties become comfortable with the solutions. When these work stoppages happen, schedules are blown, which invariably causes the budget to be exceeded. These problems are known as "schedule and/or budget creep." The level of stress placed on field personnel from all parties during these periods is directly related to the amount of money being lost while equipment sits idle on the job site, and can be extreme.

These types of problems can be exacerbated by the fact that the goals and objectives of the parties involved are generally not the same, and may even be in direct opposition. For instance, the owner's goals may be to finish the project on time, under budget and with no lost time accidents, while the Contractor's goals are to spend the least amount they can to finish the job so that they make the most money possible on the project. The design engineering firm's goals typically are to be sure the project construction specifications are met and to know if anything is discovered during construction that alters the design parameters to avoid potential liabilities. Table 1 summarizes each party's goals:

In order to solve the conflicts that arise from these different goals and objectives, Golder developed an "incentive based contract" for this project that attempted to align all three teams' goals so that everyone's incentives were the same. By doing this, the majority of the issues which arise on typical implementation projects were eliminated or avoided.

Table 1

Owner's Goals	**Design Engineer's Goals**	**Contractor's Goals**
On Schedule	Performed to Specifications	Maximize Profit
Under Budget	New Information Disclosed	Keep Own Equipment Working
No Lost Time Accidents	Avoid Lawsuits	Minimize Losses
Get Permit and Bond Release	Get Paid	Get Paid

Incentive-Based Contract

The contract used for the Fondaway Project was based on a typical "Cost Plus" contract format where payment is made based on Actual Costs plus an agreed upon amount for overhead costs and profit. This type of contract is commonly used for government projects. However, in the typical Cost Plus contract, profit is built into the overhead costs equation. For this project, profit was intentionally removed from the overhead costs equation so that it could be used to align the various parties' goals.

Envirocon, the Contractor for the project, provided an estimate of the actual costs of doing the requested work. This amount was verified by an "engineer's cost estimate" conducted by Golder. The engineer's cost estimate came in within 10 percent of the Contractor's estimate, and the average between the two estimates was agreed to by the Owner and Contractor to be used as the actual cost amount. An overhead costs amount of 8 percent was negotiated and agreed upon between the Owner and the Contractor. The total of the agreed upon actual costs and overhead

costs became the payment for the work IF none of the incentives were achieved. In effect, the only profit that the Contractor would make on the project would come from meeting the incentives.

Golder initiated the process to develop incentives by identifying the goals of the Owner and contrasting them with the other parties' goals as shown in the table above. Proposed incentives were then put forward that attempted to re-align the goals of the other two parties with the Owner's. A process of negotiation was conducted and the following list of four incentives was agreed upon by all parties:

1. $10,000 if no lost time accidents were incurred

2. $10,000 if the work was completed by the scheduled completion date

3. $20,000 if the work was performed beyond the letter of the specifications as determined by a joint committee of Golder, El Paso and Envirocon personnel at the end of the project, subject to meeting each of the following criteria in a positive manner:

    a. Identification of opportunities for cost reduction

    b. Positive interface with Golder and El Paso personnel

    c. Fair response to change orders and resolution of budget issues

4. As an incentive to reduce the rip-rap cost, the Contractor would perform work in this line item for cost plus overhead (8%) and split with the Owner any savings for rip-rap based on actual on-site and off-site quantities at line item rates, with 70% to the Owner and 30% to the Contractor. This item was evaluated subject to a review of applicability during initial mobilization.

Incentives #1 and #2 were straight forward and geared toward meeting two of the Owner's most important goals of having no lost time accidents and completing the project on time. El Paso has maintained an outstanding safety record, and above all else wished to keep this record clean. In addition, the Owner had milestones in their corporate business plan they wished to meet in regard to the project. Whenever a project schedule slips, there is also an associated budget impact. Therefore, completing the project on time was very important for both cost and schedule concerns.

Incentive #3 attempted to include some of the design engineering firm's goals, as well as the Owner's, by encouraging the Contractor to help identify any opportunities for cost reduction. Through Incentive #3a, it was hoped that any new information discovered on-site would be quickly brought to the design engineering firm's attention. Unknown facts about a site can be very damaging to both the Owner and the design engineering firm. It is impossible for design engineers, who have limited time on-site, to know all there is to know about a site. Even small unknowns, such as details about the geology below the surface, the existence of perched aquifers, the exact locations of buried water lines and other utilities, or details about the completion of water supply wells, or water monitoring wells, can make a huge difference in the

final design. Law suits often arise over these types of unknowns because it is not always clear where the lines of responsibility for gathering information about a site lie.

It may seem obvious that the design engineering firm should go to the site and gather all the information they need to safely design the project. However, in reality, it is never possible to gather all the information that is needed, or for that matter, to even know what information will be needed beforehand. Baseline studies are expensive and limits must be set early on, usually based on too little information, for the level of study to be made. Just as one example; geology and groundwater studies require drilling, and the decisions on how many holes to drill, to what depth, and by what method must be made before the drill rig is contracted and sent to the site. Having them go back, and incur additional mobilization costs, or sit idle while data is compiled and reviewed, is generally out of the question. So to move forward, designs are based on the information at hand, and the best a design engineering firm can hope for is that any information that is learned about the site that may affect that design, or make it inappropriate, is brought to their attention at a time when the design can still be changed and before the schedule and budget are impacted.

Incentive #3b was included to stimulate creativity and innovation during the implementation of the specifications. Typically, the Contractor's site manager's goal is to finish the project as fast as possible at the lowest cost by keeping the company's equipment moving as fast as possible. Any changes to his interpretation of the specifications, or slow downs for any reason, are avoided at all costs. The Owner's and/or designer's QA representative's goals are to watch out for anything that may require a need for change in the specifications, and if found, get the changes made as quickly as possible. These opposing goals can cause real stress in the field. When people are working together in a positive manner toward the common goal of a better end result, the results are much better than if there is an antagonistic relationship. This incentive was included to encourage the field managers to work together as a team to better the project. Incentive #3b was also included as an attempt to make life in the field more tolerable for the field personnel.

Adit Before closure

Incentive #3c was included to try and keep all sides working together, on the same page, when it came to disputes over change orders and budget issues. It is common knowledge that schedule and budget changes will happen on a job. The best you can hope for is that all parties will be fair about resolving any disputes that arise. Therefore, this incentive was worded as "fair response to" rather than "no" change orders or budget issues. For any incentive-based contract to work properly, the Owner must be open and willing to allow the Contractor to make a fair and reasonable profit on the job. This incentive was geared toward allowing that to be known up front, and to occur.

Incentive #4 was included to allow the Contractor an opportunity to make more profit by saving the Owner money on the project. A large amount of riprap was required to protect a channel with a very large catchment area from eroding. Although there was a potential to find

riprap on-site, at the time of contracting, it was believed that this riprap would need to be imported from over 40 miles away. This incentive was intended to provide a reason for the Contractor to pursue obtaining the riprap from on-site. In the end, no suitable riprap was found on-site and this incentive was not achieved.

Following completion of the project, the Contractor had achieved the first three incentives, but was unsuccessful in achieving the fourth incentive. This allowed them to make an estimated profit of approximately 12 percent on the project. Though this profit margin is not high, especially for contracting work which can be quite risky, the Contractor was happy with the end result. The trust they had made with the Owner provided a great in-road for future work with the company and they moved right on to other work for them. The Owner was very pleased with the end results.

In the following sections of this paper, some insight from the Designer's and Field QA Representative's perspectives on the difficulties of the project and how well the incentive-based contract approach worked for them on this project is provided.

DESIGN ISSUES

Adit after closure

Contracting issues may seem insurmountable at times, and may help alleviate some issues, but developing cost effective and practical reclamation strategies that have a reasonable chance of success can literally take years off your life. Stress goes up an order of magnitude when you have to seek approval from state and federal land management agencies with conflicting agendas. So, where do you begin? For starters - with good communication. Golder involved all necessary parties in the beginning and kept everyone focused on and engaged in resolving site issues. We facilitated the process of negotiations between EPEC and the governing bodies and employed good science and practical ideas that met or exceeded agency requirements. Most of all, we stayed focused on the goals and allowed the process to work in an equitable manner for all involved.

Initially, we became as familiar with the site as possible. We compiled information about the site, including historical aerial photographs, to conduct a roads inventory that specifically identified the Owner's reclamation responsibility. We submitted ourselves to drinking beer with the site's exploration geologist, who now operates a brewery, to determine past activities on the site. This information facilitated the development of the revised reclamation plan. We walked over the site to identify natural plant invasion mechanisms and plant species for reclamation. We collected a reasonable amount of soil, water, waste rock, and ecological site data and discussed design concepts with the Owner, the design engineers and the project team. At all times we kept our eyes open and our imagination in full gear.

In close collaboration with our engineering and project team, we used this information as the basis for development of preliminary reclamation plan revisions. This resulted in the development of feasible reclamation plans reflective of site constraints, material properties, equipment capabilities, ecological surroundings and regulatory requirements. The preliminary reclamation plan revisions were presented and discussed with the Owner for approval.

Following the development of reclamation strategies that were acceptable to the Owner, reflective of the site-specific conditions and within the regulatory constraints, negotiations with the agencies began. After a few on-site meetings with arm waving, collective reasoning, contentious debate, and meticulous written documentation, issues were resolved and prompt and appropriate decisions were made. This effectively streamlined the formal agency approval of the revised reclamation plan. Rapid agency approval was accomplished due to open discussions regarding the reclamation of the site, disclosure of corporate and agency preferences and constraints, and the equitable modification of reclamation plans in accordance with the mutually beneficial agreements made.

Once the conceptual framework for the reclamation of the site was in place a major exception was noted by the agencies. The adit had the potential of being considered a habernaculum for protected bat species that should consequently be preserved as habitat. However, it was also a discharge point on a "no discharge site" that should therefore be eliminated. Issues like these, with opposing needs can destroy an otherwise successful project. But, adjacent suitable bat habitat was identified, and with a little persistence, the bats were prohibited from re-entering the adit after a night's outing. These tasks satisfied the US Fish and Wildlife Service. Following their approval, the point discharge was eliminated and the adit was sealed. The sealing of the adit satisfied NDEP, and the site was classified as a no discharge site again. This closure approach addressed safety concerns, and creative local entrepreneurs yanking a bat gate for salvage value could not now be an issue. At this time, it was time to finalize the design, develop specifications, and assemble a bid document.

Although developing specifications, assembling a bid document and identifying good contractors can be tedious, miscommunications and unfulfilled expectations are more common than not, and good communication through all channels is critical. When miscommunication occurs with a heavy equipment/reclamation contractor you could find yourself in a difficult position and even worse, in court. To avoid this situation, it's a good idea to meticulously describe reclamation plans and designs, using appropriate and recognizable formatting, terminology and design drawing conventions. Reclamation areas, locations, volumes, lengths, actions and the means of measurements and payments must be explicitly stated. Following this a bid walk is advisable so you can meet the Contractors that will bid on the job and answer any questions they may have about the bid package. A good testament to the quality of your specifications is receipt of bid prices from prospective Contractors that are all close to your own cost estimate to implement the design. Success in selecting good contractors based on bid packages has its moments but typically past experience, reliable endorsements from former and existing clients, and the review of previous work performed by a contractor are good guides that will serve you well. Typically, specifications will include detailed requirements regarding:

- Mobilization and demobilization

- Personnel, equipment, and material
- Surveying services
- Dust control
- Materials and equipment provided by the owner and by the contractor
- Materials and equipment storage and quality
- Security measures
- Demolition
- Foundations
- Plugging drill holes, admits and shafts
- Disposing of waste materials
- Excavation, backfilling, and recontouring
- Drainage channels
- Cut/fill, slope, and alignment
- Deep ripping
- Placing cover soil material
- Seedbed preparation
- Fertilization
- Seeding and planting
- Short-term and long-term erosion control

For each of the items above, the following requirements should be identified:

- Construction quality control/quality assurance
- Contractor quality control
- Products and tolerances
- Equipment
- Execution
- Measurement and payment
- Assurance testing and frequency
- Contractor's responsibilities and submittals

At this site severe conditions limit plant growth. These limitations included low, infrequent precipitation; droughty soils, steep slopes, moderate to high soil salinity and an abundance of cheatgrass. To overcome these limitations, the following unique reclamation oriented specifications were devised:

- Random convex and concave slopes, depressions and ridges shall be created during grading and contouring.
- The surface of redistributed soils or re-graded areas shall be left in a rough, unfinished condition by gouging the surfaces with an excavator bucket or dozer-mounted ripper. When complete the surface will be very difficult for a person to walk across regardless of slope gradient.
- Plant growth medium shall not be fertilized.
- Mulch shall be crimped into the re-graded or topsoiled surface of critical sidecast road fills and waste rock covers.

At the time of the installation of the draindown collection system for the heap leach pad solutions, it was unknown how long the pad would drain. Modeling indicated a period of approximately three years, but similar real world examples did not exist at this time. At the time if installation, it was believed that the heap revegetation would be successful and final approval for bond release would be achieved before the heap stopped draining. However, due to failure of the first, second, and third attempts at revegetating the heap surface, the draindown ceased before the final approval for the heap was accepted. After the final attempt at revegetation, which was prescribed by the BLM, failed, NDEP accepted that the heap was vegetated to the maximum extent that was possible given the harsh conditions of the site. The heap had ceased to drain approximately three years following the installation of the collection system, as the model had indicated. However, the total time from capping the heap until draindown ceased was approximately five years.

Exploration Roads – before recontouring at South Hamburger Hill

Did the incentive-based contracting help or hinder the development of design specifications or the implementation of them in the field? Knowing that the Contractor would have an incentive to work with the QA personnel in the field to disclose any abnormalities found during construction takes some pressure off the design engineers, but does not totally alleviate the need for making every effort possible to learn what they can about the site. Knowing that the field personnel will work together as a team to implement the specifications provides some comfort but does not remove the responsibility and liability of the design engineer. In the end, the incentive-based contracting helps build confidence that the specifications will be met and/or that any needed changes will be identified and made. Perhaps most useful is the sense that open lines of communication will likely be easier to maintain, and that is never a bad thing.

The site Field QA Representative is responsible for taking the design specifications described above, interpreting them, describing design tolerances to the Contractor, performing construction

quality assurance, measuring the work performed and signing off on payment approval. Her description of the difficulties involved in these tasks are provided below.

IMPLEMENTATION ISSUES

Many project related issues simply cannot be solved just by good contract writing, scheduling, budgeting, and design. Some issues can be addressed only by being well prepared and diligent in the field, DURING the actual implementation. A good Field QA Representative can make or break a job. If things go smoothly, on time and there are no huge change orders, it may have something to do with the contracting, budgeting and design, but most likely it will also have a great deal to do with how well the field oversight is conducted.

For a project to go smoothly the Field QA Representative (QA Rep) needs to develop and maintain a thorough knowledge of the specifications before ever getting to the site. This allows the QA Rep to interact with the designers face-to-face in the office, or at least under minimal pressure over the telephone, to firm up details and concepts that the designer had in mind when writing the specifications, and enables the QA rep to go to the field with the knowledge necessary to avoid requesting items that are outside the scope of the contract in the first place. Reading the specifications and learning that "dozer basins" will be installed is one step in the preparation process, but knowing exactly what the finished product should look like may be another, more intangible step. Without confirming with the designers, through discussion and preferably a review of photographs or sketches that show examples of the desired feature, the QA Rep may not be able to "read the designers' minds" and consequently may not push for the desired effect in the field.

Reviewing the project contract also is essential and valuable, so that the QA Rep understands the bigger picture – the overall cost, anticipated schedule, any incentives that have been included, and the roles of the different individuals involved in the project. For the Fondaway project, the QA Rep was able to go to the field with a knowledge that the Contractor would profit from being safety conscious, efficient, cooperative, and communicative about site conditions.

Another step in preparation prior to going to the field is for the QA Rep to review effective communication approaches when interacting with a contractor. Talking with others who have worked with contractors can be very beneficial both for those new to QA and for those who are seasoned. We all can benefit from being reminded that getting into yelling matches with a contractor is not effective, and that at day's end taking "home" the stress of conflicts that arise from implementing office-developed specifications in the field is not productive.

A final step in preparation prior to heading to the site is to review the potential health and safety concerns that exist at the site. Any field personnel should become familiar with safe field practices, such as how to work around heavy equipment, or work in rough terrain with physical and biological hazards (rocks and rattlesnakes in this case). Also, although the QA Rep is not responsible for the health and safety of the contractor, the QA Rep will be better able to provide feedback to the owner and design firm's project manager regarding the safe work practices of the contractor.

Heading into the project with a sense of what to expect is a much better scenario for a QA Rep, whether the person is new to reclamation work, or experienced – because every project is different. The field of reclamation is a science, or even an art form, rather than a linear, calculated engineering field. While specifications can be written to be as detailed as possible, field conditions greatly affect the potential for successful implementation of the specifications. For this project, situated in a steeply sloped mountainous region, estimation of the effort required to replace fill on exploration roads, or to recontour a surface that had been disturbed, was difficult. Typically for an abandoned mine reclamation project, no exhaustive baseline studies are performed where soil and rock samples are collected from across the site and analyzed to determine consistency and competence of the on-site materials. Without having performed these studies prior to field work, the design engineer must assume certain conditions. Often field conditions do not match the assumed conditions, and the specifications may need to be adjusted, or approaches changed.

Consequently, throughout the project the QA Rep needs to confer constantly with the project manager related to any and all issues that arise, and obtain confirmation about how the contract applies to those issues. The QA Rep also needs to be in constant communication with the reclamation designers during construction so that the designers can be aware of field conditions and given those conditions, can identify any changes that may be necessary to attain the desired results. Sometimes, quantities of material to be moved (i.e., "1 cubic yard of soil") estimated in the office can turn into a lot more than that (tens or hundreds of cubic yards) in the field. Because contractors develop cost estimates based on the office-estimated quantities, they want to stick to those estimated quantities. If field conditions differ, and more material has to be handled, the contractor is faced with added costs that are not included in the agreed-upon contract payment price. The contractor either will have to absorb those unexpected costs, or request a change order from the client to cover the costs.

This situation will lead to a conflict that will have to be resolved among the contractor site supervisor, the QA Rep, the owner, and the design engineer's project manager. Communication is the key to resolving such a conflict.

A QA Rep must always talk with the contractor's site supervisor, rather than the equipment operators, when explaining the desired effect or end product, or when indicating that a change in approach is necessary to obtain the desired effect or product. This necessity often results in a "whisper-down-the-line" effect, as the site supervisor then has to pass on the information to a middleperson, such as the foreman, who then talks with the equipment operator. Making sure the desired information actually flows down to the guy doing the work to produce the desired effect is crucial. While it is easy to fall into the habit of talking to the equipment operator, or the foreman, because that person is easily accessible and directly involved, the QA Rep constantly must remember to talk with the contractor's site supervisor, even if that means stopping work (always viewed as a "bad" thing by a contractor) and driving from the work area to the staging area or wherever the site supervisor may be, which on large or mountainous sites can take 15 minutes' drive or more. When talking with the site supervisor about an issue, a QA Rep must be clear, detailed, and specific when explaining desired effects or end products, and must refer to the specifications during discussions and be as familiar with the specifications as the design engineers who developed them were to be sure the goal is translated as intended.

The overall key to contributing to a successful field project is for a QA Rep to keep ALL of the lines of communication open. The best way to achieve that open communication is to implement an effective conflict resolution protocol: involve all parties – owner, contractor, design engineering firm's project manager, QA Rep, design engineer (if necessary); identify several alternatives and then pick the most appropriate one to solve the problem; inject some levity where appropriate to remind everyone that this is only work; and get the work completed in a way that does not put up walls that hinder further communication or degrade the quality of work performed after the conflict. It's no wonder that many people are not good at this, because effective communication among so many parties is extremely difficult!

Lastly, the QA Rep must constantly check to make sure the desired effects are reached in the field, on the ground, WITHOUT interfering or slowing the actual work. (It often requires "Multi-tasking," can we analytical thinking types say that?) In order to be "there" when the work is going on, wherever "there" is – and often when "there" is two or more places on a large site at one time, the QA Rep needs to use all tools available, which include effective transportation, and effective communication tools. An ATV, or 4-wheel drive vehicle, is a critical piece of field equipment for a QA Rep, even though people not present on the project site may think that such a vehicle would be a toy to play with. Also, two-way radios or cellular telephones are essential to the QA Rep's safety as well as her/his effectiveness on the job. Another essential tool for the QA rep is a digital camera. Pictures do speak thousands of words, and by taking a photograph of the site and emailing it to the project manager and design engineers, the QA Rep can get a point across much more quickly and effectively. Time is of the essence during a field job, and describing details in words on the telephone, especially when breaks in cellular service can unexpectedly end conversations, can take much longer, and can introduce the risk of unclear translation of the information.

For the Fondaway project, having an incentive-based contract in place provided motivation for the contractor, in the form of financial reward, to resolve conflict in a quick and hospitable manner; and simultaneously the contract provided leverage for the QA Rep to use when interacting with the contractor to obtain the desired construction goals. Furthermore, the incentive-based contract seemed to encourage a more open-minded approach to challenges that arose in the field.

CONCLUSION

The incentive-based contracting did prevent some of the problems that typically arise on field implementation projects. And because the design was well thought-out and detailed, many issues were addressed before they became problems. But, no matter how well a project is designed and contracted, it can't be implemented on schedule and within budget without good oversight and good communication between all parties. In the end, it takes all parties working well together, to make a project successful.