




Rio Algom Mining LLC
Final Report

Red Water Pond Road Removal Action
Church Rock Site, McKinley County, NM
Rio Algom Mining LLC

Prepared By:

Conestoga Rovers & Associates Ltd.
and SENES Consultants Limited

February 2013

Rio Algom Mining LLC

February 15, 2013

Via email and Courier

Environmental Protection Agency
Mr. Mark Ripperda
U.S. EPA, Mail Code SFD-8-2
75 Hawthorne Street
San Francisco, CA 94105

RE: Red Water Pond Road (RWPR) Removal Action - Final Report

Dear Mr. Ripperda,

In accordance with Paragraph 23 of the Unilateral Administrative Order issued by the United States Environmental Protection Agency to Rio Algom Mining LLC (U.S. EPA Region 9 CERCLA Docket No. 9-2012-08), attached is the "Final Report" required by the referenced Unilateral Order.

This Final Report complies with all of the requirements contained in Paragraph 23, and constitutes the final action required of Rio Algom Mining LLC by the terms of the referenced Unilateral Order.

Pursuant to Paragraph 65 of the referenced Unilateral Order, please provide me with written notice that the EPA has determined that all of the terms of the referenced Unilateral Order have been completed to the EPA's satisfaction, and that the referenced Unilateral Order has been terminated."

If you have any questions regarding the following you can contact me at 520-531-6927.

Sincerely,

Kenneth Black

Representative Agent for RAML Environment and Community
8950 N. Oracle Road, Suite 150
Tucson, Arizona 85704

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Rio Algom Mining LLC
Final Report

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RED WATER POND REMOVAL ACTION
FINAL REPORT

Prepared for:

Rio Algom Mining LLC

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February 2013

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ACRONYMS AND ABBREVIATIONS

CERCLA	*Comprehensive Environmental Response, Compensation and Liability Act*
CFR	U.S. Code of Federal Regulations
C-O-C	Chain of custody
cpm	Counts per minute
CR1	Church Rock 1
CRA	Conestoga Rovers & Associates
yd^3	Cubic Yards
DCGL	Derived concentration guideline level
DQA	Data quality assurance
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning Site
H	Horizontal
ID	Identification
Lat	Latitude
Long	Longitude
MARSSIM	Multi-Agency Radiation Site and Survey Investigation Manual
MDC	Minimum detectable concentration
MDL	Method detection limit
N	North
NaI	Sodium iodide
NM	New Mexico
NMDOT	New Mexico Department of Transportation
NNEPA	Navajo Nation Environmental Protection Agency
OSL	Optically Simulated Luminescence
%	Percentage
pCi/g	Picocuries per gram
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
RA	Removal Action
Ra-226	Radium-226
RAML	Rio Algom Mining LLC
RSE	Removal Site Evaluation
RWPR	Red Water Pond Road
SENES	SENES Consultants Limited
SOPs	Standard Operating Procedure
SOW	Scope of Work
TLD	Thermo Luminescent Dosimeter
UNC	United Nuclear Corporation
UAO	Unilateral Administrative Order
µg/cu. M	Microgram per cubic meter
µCi/ml	Micro Curies per millilitre
V	Vertical
W	West

1.0 SUMMARY REPORT OF REMOVAL ACTION

1.1 GENERAL INFORMATION

Milestone Dates:	
Start Date:	October 1, 2012
Demobilization Date:	November 20, 2012
Completion Date:	December 6, 2012
Name of Person (from):	Kenneth Black, RAML
Name of Person (to):	Mark Ripperda, EPA
Site Name:	Red Water Pond Road Removal Action
Map ID	E4, Mine ID 305
Site Identification Number:	09QM
CERCLA Number:	Docket No. 9-2012-08
NPL Status	Not Applicable
Response Authority	EPA Region 9, Superfund
State or Tribal Notification:	Michele Dineyazhe, NNEPA
	David Taylor, Navajo DOJ

1.2 DESCRIPTION OF RED WATER POND ROAD REMOVAL ACTION

1.2.1 Introduction

This Red Water Pond Road (RWPR) Final Report describes the purpose, the approved scope of work, construction methods and the field verification surveys employed in the execution of work completed in accordance with the United States Environmental Protection Agency's (EPA) *Unilateral Administrative Order (UAO) [CERCLA Docket No. 9-2012-08]* issued to Rio Algom Mining LLC (RAML), the UAO's associated Scope of Work and the RWPR *Removal Action Work Plan (SENES, 2012)* (Work Plan). The Work Plan was prepared in accordance with the provisions of the UAO. Together, these documents comprise the RWPR Removal Action unilaterally ordered against RAML by the EPA. The UAO dictated all of the work performed and the remedial standards. The UAO did not allow any analysis of alternatives to any of the work it required. The EPA provided field oversight and approved of minor changes based on conditions encountered through the approval of Work Plan amendments.

The RWPR Removal Action required: 1) The excavation and removal of soils from the RWPR and the adjacent areas to the fence line on either side to the depth necessary to reach 2.24pCi/g from the shoulder of the RWPR to the fence line from State Highway 566 to the south running approximately 1,800 feet north to the bridge over the Un-named Arroyo No. 2 just south of the Quivira Church Rock 1 (CR1) site; 2) the placement of those excavated materials at CR1; 3) the re-construction of the road and shoulder area; and 4) the re-vegetation of those areas.

The EPA imposed an arbitrary criterion of 2.24 pCi/g for the RWPR area based on residential risk assessment completed at a nearby site. This value was derived from a background of 1.0pCi/g established at that site and a risk-based increment of 1.24 pCi/g that is not likely appropriate for the exposure conditions on the RWPR.

1.2.2 Site Description

The RWPR area is located northeast of Gallup, McKinley County, New Mexico off State Highway 566. The details of location and ownership are listed below:

Location:	Red Water Pond Road, McKinley County, New Mexico
RWPR Site Lat/Long:	~35˚39'55.43"N, 108˚30'10.69" W
Area of Disturbance:	4.7 acres
Ownership:	Navajo Nation

The construction work was conducted between October and November, 2012 in accordance with the technical specifications and designs presented in Removal Action Work Plan. Minor variances from the plans and specifications were approved by the EPA Project Manager during construction and do not materially impact the performance of the remediation of RWPR, or modify the performance of mitigating measures. The field changes are indicated in and marked on the as-built drawings enclosed with this report in Appendix C.

In addition to the 1800 feet of roadway work carried out under the UOA, some earthworks were also carried out north of the bridge over the Unnamed Arroyo No.2 that generally included some excavation, regrading, and wear surface placement on the RWPR and the entrance to the CR1 site. Excavated soils and debris from the RWPR area were relocated and stored at the CR1 site in accordance with the UAO requirements. Figure 1.1 is an approximate area of the RWPR Removal Action.

1.2.3 Reference Materials

Descriptions and features of the Red Water Pond Road area were presented in Section 1.0 of the *Red Water Pond Road Removal Action Work Plan (Work Plan, SENES, 2012)* and the *Scope of Work for Unilateral Administrative Order Red Water Pond Road Removal Action* (*EPA CERCLA No. 9-2012-08*). In addition, a number of field changes that were agreed upon in the field with EPA and these included:

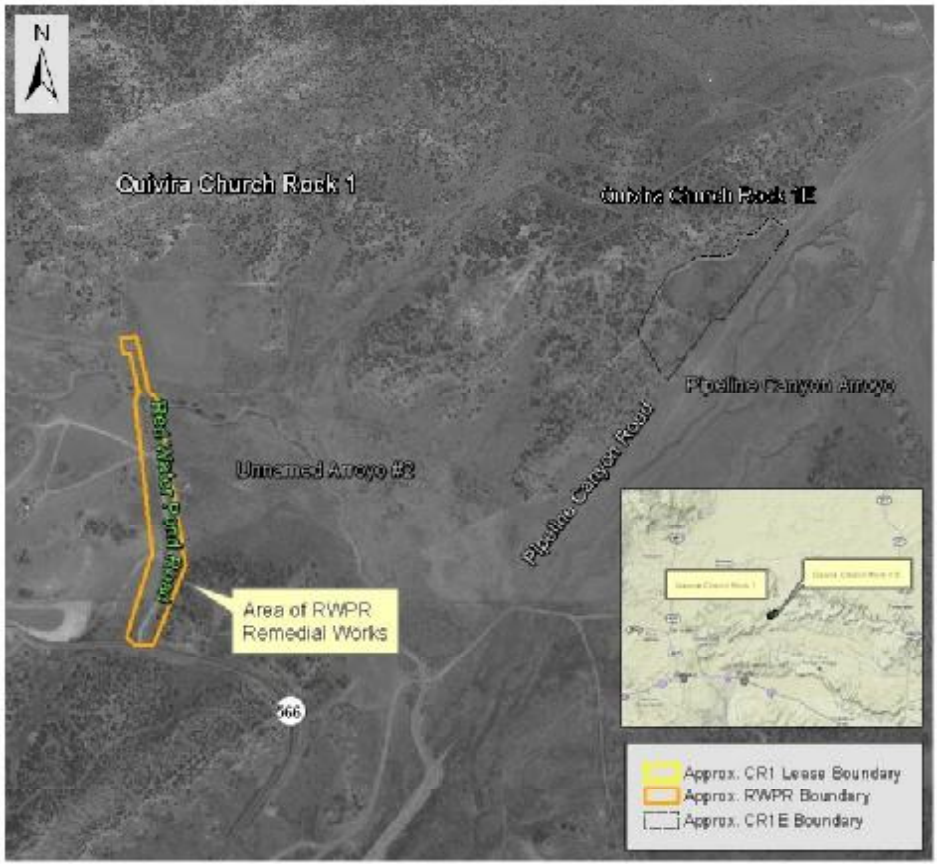
- Setback limits around bridge approaches;
- Setback limits around power poles;
- Setback limits to established fences; and
- Improvements to RWPR as per community requests.

1.2.4 Document Organization

Section 2.0 provides details of the RWPR Removal Action. Section 3.0 discusses the verification testing to demonstrate compliance with the UAO requirements. The site activities related to the facility improvements are discussed in Section 4.0. Section 5.0 reflects the costs associated with this removal action. Certification of work is referenced in Section 6.0. Sections 2.0, 3.0 and 5.0 specifically address the Final Report requirements as specified in paragraph 23 of the UAO.

Photographs of pre-construction, construction and post-construction activities are included in Appendix A. The results of the verification testing are summarized in Appendix B. Annotated existing condition drawings and as-built construction drawings are attached in Appendix C. Appendix D contains information on the material characterization and usage. Appendix E presents the testing and monitoring of employees to ensure that worker safety protection measures were taken during the RWPR Removal Action. Final reclamation vegetation specification data are enclosed in Appendix F. Appendix G contains the raw radiological results and chain of custody for the occupational and environmental monitoring. Appendix H includes support cost data for the RWPR Removal Action.

Figure 1.1 General Location of RWPR



2.0 DETAILS OF THE REMOVAL ACTION

As required by the UAO, the RWPR Removal Action included removal of road materials and soils from the RWPR and its right of way to the depth necessary to reach 2.24pCi/g, the re-construction of the road and shoulder area to promote safe transport and positive drainage to the shoulders, and the re-vegetation of the shoulders from the edge of road to the road fence line. The UAO required that the excavated materials be transported to CR1 and placed on the surface of the existing CR1 waste storage area in such a manner so as not to impound surface drainage water.

The placed materials were graded, shaped, compacted and covered with a soil cap to control the potential release of these materials offsite. The roadway proper was reconstructed to New Mexico Department of Transportation road standards and the excavated shoulder areas were re-vegetated with native species. Straw wattles were added to control stormwater drainage during the period of re-vegetation and prevent the migration of soils. The construction and field environmental work was conducted without incident.

2.1 WORK SCHEDULE AND APPROACH

The UAO required that RWPR Removal Action commence construction activities upon completion of a separate Removal Action to be conducted by the United Nuclear Corporation (UNC) at an area adjacent to portions of the RWPR called the Eastern Drainage. UNC's work on the Eastern Drainage was scheduled for completion by October 1, 2012 and RAML developed a construction scheduled based on full access to the RWPR. RAML's construction team proposed to excavate the full width of the road and shoulder in a single pass commencing from the intersection of 566 and RWPR and advancing the removal from south to north, and the EPA approved that proposal.

2.2 ACTUAL IMPLEMENTATION APPROACH & SCHEDULE

RAML mobilized construction and field support personnel on October 1, 2012. A week was allocated for safety training, installation of a field office, pre-construction surveys and equipment mobilization.

With delays in UNC's removal action, RAML's schedule and construction approach was altered to allow UNC's contractor to complete the hauling of materials along RWPR although he UNC removal action was not completed until on or about October 26, 2012. This was agreed in a discussion with EPA and UNC.

2.3 SEQUENCE OF WORK

Pre-construction engineering and environmental assessments were conducted prior to the commencement of construction activities on October 1, 2012. Environmental assessments consisted of a baseline vegetative survey which was conducted in the latter part of August by Bamberg. A cultural survey was also conducted during the same timeframe by Dinétahdóó

Cultural Resources Management LLC. The findings of these studies are reported in Appendix G and I respectively, of the RWPR Removal Action Work Plan (SENES, 2012).

A pre-construction engineering survey was completed in late August and updated during the construction phase of the project. The purpose of this survey was to verify existing conditions, delineate work areas, and determine site access points and the location for temporary facilities, such as; field office, tool crib, sanitary facilities, equipment staging location, soil and material stockpile areas. RAML's contractor completed a topographic survey of the entire project site to confirm pre-construction conditions and establish road and shoulder area profiles and grades.

2.4 DESCRIPTION OF MATERIALS AND SOURCES

2.4.1 Sources

Prior to the construction work materials from two nearby pits were tested for use as aggregate material and a single pit for backfill material was tested. All facilities were in a radius of 60 miles from the site. The material East Ready Mix transload facility in Gallup met the New Mexico Department of Transportation (NMDOT) gradation specification; however the naturally elevated radioactivity levels of aggregate from this source did not meet the radiological requirements. An alternate source of aggregate, the Gallup Sand and Gravel Pit (Thoreau, NM) was tested and met construction and radiological specifications.

2.4.2 List of Materials and Quantities

Material type and locations are summarized in Table 2.1 below.

Table 2.1 Material Type, Locations and Quantities

Type of Material	Source	Location	Quantities (cubic yards (yd^3))
Excavated Material	RWPR Area	CR1 Disposal Area	17,374
General Fill	McConnel East Pit	Rehoboth – Highway 66	13,673
Road Base	Gallup Sand and Gravel	NE of Thoreau, NM	1,393
Riprap	Gallup Sand and Gravel	NE of Thoreau, NM	155

2.4.3 Material Test Results

Imported cover material and general fill material were pre-qualified for use prior to the construction project. Ten soil samples were taken from the McConnel Enterprise pit located in Rehoboth, New Mexico. These samples were identified as soils and laboratory analysis of this material is presented in Appendix D.

Prior to importing road gravel, from Gallup Sand and Gravel pit in Thoreau, NM, a sample was taken to assure that proper NMDOT specifications were met. The geotechnical test results are located in Appendix D.

2.5 REMOVAL, PLACEMENT AND DISPOSAL OPTIONS

The UAO did not permit RAML to evaluate removal or disposal options.

2.5.1 Removal of Materials

The excavation of materials was performed under the conditions of, and is in conformance with, the following reference documents as applicable.

- Scope of Work for Unilateral Administrative Order Red Water Pond Road Removal Action for Quivira Mine Site.
- New Mexico State Department of Transportation Specifications for Highway and Bridge Construction.

2.5.2 Disposition of Materials

RAML excavated and removed approximately 17,374 yd^3 of material that was placed on top of the CR1 waste storage area as required by the UAO. In addition, while not required under the UAO, material was excavated in the area north of bridge.

Excavated material was placed in lifts on the CR1 storage area to a maximum depth of 12-inch which were subsequently sloped, compacted with imported fill, and re-vegetated. The relocated material was graded so that the slopes of the waste stockpile area did not exceed 4H: 1V. A total of 3,570 yd^3 of fill material was imported and used to support the growth of native vegetation, an integral component in maintaining the effectiveness of the waste pile cover.

2.5.3 Placement of Materials

Upon completion of excavation of waste materials from RWPR area and its shoulder area, approximately 13,673 yd^3 of imported general fill was trucked and placed on the remediated areas. The contractor used a D5 dozer, grader, and skid steer to spread general material that was delivered by 15 yd^3 dump trucks. The area was graded and rolled to achieve water drainage flow that had existed before the removal of the impacted material as required by the UAO.

The imported fill material was used as roadway subgrade and general fill. The material was free of debris (trees, branches, stumps and rocks greater than 2 inches. All material used for subgrade and general fill met compaction requirements of 95% standard proctor.

A 6 inch road base coarse material used to top dress the road surface met NMDOT standards. Riprap material (i.e. < 5 inch) was used in drainages at the inlet and outlet of culverts.

2.5.4 In-Situ Testing

This task consisted of field testing of the road subgrade and 1 inch road gravel top course. Terracon Consulting Engineers (Gallup, NM) were retained to perform the soils testing required by the project specifications.

Terracon Consulting Engineers performed the following laboratory tests:

- Structural Fill – Subgrade ASTM D698
- 1-inch Road Gravel – Road Base ASTM D698

Field test data has been included in Appendix D of this report.

2.6 REVEGETATION

All disturbed areas; except the road surface, were re-vegetated in accordance with the RWPR Removal Action Work Plan (SENES, 2012). The limits of the re-vegetation work are indicated on the drawings in Appendix C of this report and include approximately 4.7 acres of road shoulder and 4.8 acres of storage area at CR1.

2.6.1 Seed Mix

The seed mix in the approved Work Plan was modified and approved by the U.S. EPA to account for the addition of a species recommended by the community. Additional changes to seed mix were necessary owing to limited availability of some seeds due to late planting season. The non-road portions of the RWPR area were seeded in November 2012 and the seed mixes used are presented in Appendix F of this report.

Hydroseeding was used on all shoulder areas of the RWPR and the disposal area of CR1. Prior to seeding the ground surface was cultivated to a depth of 3 inches using a drag until the soil was uniform in texture and suitable for seed application. During application of the seed, hydraulic adhesive and hydraulic mulch were added to help stabilize the seed and soil until germination can be achieved. Application rates, seed mix, and seed tags have been included in Appendix F.

2.6.2 Erosion Control

The existing surface water drainage was not altered by the RWPR Removal Action Erosion protection immediately following seeding was enhanced by means of mulch and tackifier applied over the seed. Erosion control methods (straw wattles) were implemented to all portions of the site that may be susceptible to erosion until vegetation is fully established.

In areas where concentrated water flow is likely and where the slopes exceeded 4H: 1V, erosion control blankets were installed as shown on Drawing SW1. Approximately 22,500 square feet of blanket was installed.

In areas where slopes were less than 4H: 1V and concentrated flows is likely, 12 inch straw wattles and riprap were installed as shown on Drawing SW1. Approximately 6,160 lineal feet of straw wattles and 155 yd^3 of riprap material were placed to control erosion.

2.7 SITE INSPECTIONS

On-site RAML management team worked closely with RAML site contractors (CRA Services and SENES Consultants) in the safe execution of the project. Routine safety and environment inspections were conducted daily to assure compliance with the requirements with the UAO. In addition, the Site Manager coordinated technical, regulatory and community dialogue on as needed basis.

3.0 VERIFICATION TESTING PROGRAM

Environmental monitoring and verification testing was conducted during the program to confirm that remediation of RWPR area was complete and met the UAO criterion and to address potential public and occupational health and safety.

3.1 SAMPLING RATIONALE AND OBJECTIVES

A sampling program for verification was proposed by SENES and accepted by EPA for the confirmation that excavation met the UAO criterion of 2.24pCi/g Ra-226 over a 6 inch soil depth horizon (SENES 2012). The sampling rationale and objectives for confirmation of remediation included field verification based on field measurements of surface gamma radiation that could be correlated with soil Ra-226 concentrations. Gamma radiation measurements during the excavation process were used to direct the need for additional excavation until such time as gamma radiation measurements for an excavated area met the gamma radiation criteria.

During the excavation process a high density gamma radiation scan was conducted following excavation of various areas and these areas were considered to meet criterion if the average gamma radiation levels were statistically significantly below the clean-up criteria. Following field verification by gamma radiation, soil samples were collected from the 0 to 6 inch soil horizon for laboratory analyses of Ra-226 concentrations for reporting purposes to show that the clean-up had met the UAO criterion.

Three survey units had been determined in the work plan with two survey units located south of Unnamed Arroyo No. 2 bridge where the UAO required actions and a survey area north of the bridge.

During the remediation, although not required by the UAO, with the permission of EPA additional excavation was performed north of the Unnamed Arroyo #2 bridge.

EPA agreed that no excavation works were to be carried out in the immediate vicinity south of the RWPR bridge over the Unnamed Arroyo #2 to ensure the integrity of the bridge structure and surrounding soils. This resulted in a reduced number of samples for this survey unit as one sample had been assigned to this area prior to the field decision being made.

Additional environmental monitoring including high volume sampling of ambient air uranium and Ra-226 concentrations, worker breathing zone samples and radiation exposures. These programs are described in Appendix E and indicated conditions well below regulatory requirements.

3.2 QUALITY CONTROL PROGRAM

Quality control programs for radiation monitoring program were conducted throughout the construction period. This included daily checks of gamma radiation monitoring equipment operation along with replicate soil sampling and validation and verification of sample measurements. These results are provided in Appendix B.

3.3 FIELD RADIATION SURVEYS

External gamma radiation measurements were collected with a high density gamma radiation scan program using automated collection of GPS coordinates and gamma radiation measurements. These measurements indicated that the remediated RWPR area met the UAO criterion of 2.24pCi/g Ra-226 and the elevated measurement concentration of 3.0pCi/g based on averaging of the gamma radiation measurements as described in the approved sampling plan.

Composite soil samples were collected from the 0 to 6 inch soil horizon and these demonstrated that the remediated area met the criterion. The results of the field verification are summarized in Figure 3.1 and detailed in Appendix B.

Relationships between gamma radiation count rate and soil Ra-226 concentration were developed from previous characterization of the site (RSE 2011) so that Ra-226 concentrations were predicted by the gamma radiation levels. Gamma radiation measurements were used to direct the excavation process and, following complete excavation, provided field verification that the UAO criterion was met.

Confirmatory soil samples were collected from the remediated sections of the RWPR area to confirm the assessment by gamma radiation measurements that the areas met the criteria of 2.24pCi/g average for the survey unit. Samples were also collected from imported off-site borrow materials to verify that these materials did not exceed the radioactivity, Ra-226 concentration and gamma radiation level, corresponding to the local background.

Plate B2-1 in Appendix B shows the random soil sampling locations were specified for the two survey units south of the Unnamed Arroyo #2 Bridge with an intended number of fifteen (15) samples per survey unit. A five-spot composite sample of the 0 to 6 inch layer was collected from selected 10 m by 10 m blocks from the center sample plus four locations 1 meter inside each of the corners as per the approved Work Plan (SENES, 2012).

Figure 3.1 Field Verification by Gamma Radiation Measurements

4.0 ADDITIONAL FACILITY IMPROVEMENTS

During the construction phase, a series of community meetings were held with local stakeholders. Pursuant to the request of the EPA, RAML agreed to conduct additional work outside the specific requirements of the UAO to construct the following.

4.1 ROAD EXTENSION REGRADE AND CATTLE GUARD

Following removal of the impacted material and importing of the general fill and cover material, road modifications were completed to the north of the bridge on RWPR. Approximately 550 lineal feet of regrading of the road subgrade and installation of 6 inches of 1-inch road gravel was completed. In addition to this work the cattle guard on the extension of the RWPR was cleaned-out and new side rails and fencing installed.

4.2 CULVERT REPLACEMENT

The existing storm water conveyance culvert (Culvert No. 1) was removed and replaced with a 30 inch culvert. The captured drainage water tied into the outlet drainage riprap work completed by UNC on the Eastern Drainage. An additional 24 inch culvert was installed in the road shoulder that collects water upgradient in the east shoulder of the road and drains into the No. 1 culvert outlet channel. The surface water conveyance controls as constructed are shown on Drawings AB 3 and AB 4 of the As Built drawings (see Appendix C).

4.3 RWPR CATTLE GUARD

An 8' x 32' cattle guard with cleanouts and wings, was installed at station 3+75 as shown on Drawing AB 2 on the As Built drawings (see Appendix C). After installation, fencing was installed between the existing fence line and the cattle guard.

5.0 ESTIMATE OF COSTS

The following Table 5.1 is a good faith estimate of the costs to comply with the RWPR Removal Action and Scope of Work outlined by EPA in this Unilateral Order. The direct and indirect cost details are provided in invoices in Appendix A to this report.

Table 5.1 Project Cost Estimate

Categories	Cost Elements	Amount	Description of Activities
Direct Costs	CRA Contractor	$975,000 (1)	Removal and placement of materials, engineering and remedial measures
	SENES Contractor	$251,000	Engineering and environmental services
Indirect Costs	RAML Project Management	$135,800	Labor and expenses
	Legal	$53,200	Legal
Totals		$1,415,000	

(1) Costs include excavation north of bridge and facility improvements

6.0 CERTIFICATION

This report entitled "Final Report for Red Water Pond Road Removal Action" was jointly prepared by Conestoga Rovers and SENES Consultants Limited. The supervision of the preparation of this report was performed by Kenneth Black of Rio Algom LLC.

"Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all the relevant persons involved in the preparation of the report, the information submitted is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Kenneth Black

7.0 REFERENCES

SENES Consultants Limited (SENES) 2012. *Removal Action Work Plan for Red Water Pond Road. Unilateral Administrative Order CERCLA Docket No. 9-2012-08.* September.

SENES Consultants Limited (SENES) 2011. *Interim Removal Action – Final Removal Site Evaluation (RSE) Report for Quivira Site Evaluation for Church Rock (CR-1) and CR-1E) Mine Sites.* September.

United States Environmental Protection Agency (U.S. EPA) 2012. Unilateral Administrative Order for Red Water Pond Road Removal Action at the Quivira Mine Site, CERCLA Docket No. 9-2012-08, August.

United States Environmental Protection Agency (U.S. EPA) 2008. SW-486, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, 3rd Edition.

United States Environmental Protection Agency (U.S. EPA) 2007. EPA Method 903.1 (Modified), *Section 7, Radium 226 in Drinking Water, Radon Emanation Technique.*

United States Environmental Protection Agency (U.S. EPA) 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, EPA 402-R-97-016, Rev. 1.

APPENDIX A

Photographs

LIST OF PHOTOGRAPHS

Red Pond Road Removal Action

Photograph 1 - Red Water Pond Road Area – Pre-reclamation (looking N)

Photograph 2 – Red Water Pond Road Area – Looking S from CR1

Photograph 3 – West side of RWPR Area at Culvert 1

Photograph 4 – Cut on east shoulder of RWPR Area above culvert (looking S)

Photograph 5 – Road removal (looking N)

Photograph 6 - East shoulder of RWPR Area below Culvert No. 1 (looking S)

Photograph 7 – Excavation of road south of bridge

Photograph 8 – Excavation of east shoulder of RWPR Area above arroyo

Photograph 9 – Making the road traffic worthy before weekend shutdown

Photograph 10 – View of RWPR and shoulder excavation (looking S)

Photograph 11 – Final road excavation prior to fill placement (looking S)

Photograph 12 – Dust control measures

Photograph 13 – Excavation of east shoulder drainage to outlet of Culvert 1

Photograph 14 – Final shoulder excavation above Culvert 1

Photograph 15 – Disposal material site at CR-1

Photograph 16 – Disposal area at CR-1 (looking SE)

APPENDIX B

Monitoring, Verification Testing and QA/QC

APPENDIX B1: QUALITY ASSURANCE

B1.1 Quality Control Program

A Quality Assurance Project Plan (QAPP) was developed for the project and is presented in Appendix C of the Removal Action Plan (RAML, 2012). The QAPP was prepared to describe the project requirements for all field and contract laboratory activities and data assessment activities associated with the Work Plan. Additionally, the QAPP provides guidance that establishes the analytical protocols and documentation requirements to ensure the data are collected, reviewed, and analyzed in a consistent manner.

This appendix contains the calibration and quality assurance checks performed on the instruments and the validation worksheets performed on analytical results of the soil samples.

The routine quality control activities are summarized below.

1. All portable hand held radiation instruments as shown in were factory calibrated within a year and daily checks were performed to ensure proper operation.
2. The Staplex air samples were calibrated within six months of use with the Staplex Model CKHV810 and the flow rate was adjusted daily to 40 cfm.
3. SKC Airchek 52 pump, breathing zone, were calibrated the beginning and end of each day when in use with a Mini-Buck Model M-5 Calibrator.
4. Optically Stimulated Luminescence (OSLs) dosimeters were provided by a dosimetry lab accredited under the National Voluntary Laboratory Accredited Program (NVLAP).
5. Verification and validation were performed on the soil sample chain of custody forms and analytical results.

B1.1.1 Gamma Instrumentation

Rio Algom Mining LLC (RAML) provided gamma meters which were used in the field for surveying gamma levels during remediation of Red Water Pond Road. The meters for gamma scanning were digital ratemeter with built-in scaler unit (Ludlum 2221) with a 2×2 inch sodium iodide (NaI) scintillator (Ludlum 44-10) collimated with a lead shield. These instruments were chosen because of their previous use at RAML's Ambrosia Lake facility and their wide use in the uranium industry.

B1.1.2 Alpha Instrumentation

RAML and Environmental Restoration Group (ERG) provided alpha probes and meters used for surveying of; personnel, equipment, smears/wipes and air sample filters. The probes used for personnel, equipment and air filter sample surveying were ZnS (Ag) scintillators with 50 cm^2 aluminized Mylar windows (Ludlum 43-1) attached to an analog ratemeter (Ludlum 4). The probes used for smear/wipe counting were also ZnS(Ag) scintillators, either 75 cm^2 aluminized

Mylar window paired with a general purpose scaler or windowless probe paired with a digital ratemeter with built-in scaler. Smears taken were on a judgmental basis on equipment permanently leaving the site.

B1.1.3 Instrument Calibrations

All portable handheld meters instruments were calibrated by an outside "third party" entity. Each meter was paired with a specific detector and was calibrated as a unit and used as a unit in the field. Instruments were re-calibrated once a year under normal circumstances. However, if the meter or detector was damaged, dysfunctional, or failed the function check (see function checks below), the unit was sent in for repair and re-calibration.

Staplex air samplers were calibrated on site prior to use and the breathing zone samplers were calibrated daily before and after use.

B1.1.4 Function Range Checks and Daily Function Checks

After calibration, a function range check was performed on the instrument and detector pair to provide an acceptance range for the daily instrument function checks. The function range check was determined by averaging a set of 10 readings observed with the source and geometry that was for the daily function checks, then taking +/- 20% of this value.

Daily, when in use, function checks were performed for the selected instrument (meter and detector) to ensure that it was functioning properly. The function range and daily function check were performed by counting the appropriate check source within a set geometry in relation to the instrument and an observed count is made. The instrument passed if the resulting value fell within the function range check limits and it could be used for surveying. The instrument failed if the instrument response fell outside of the function check range. If the instrument failed, the reason for the failure had to be determined, or the meter was taken out of service and returned to the manufacturer or supplier for re-calibration and repair as necessary. An equivalent replacement instrument was used that passed the function range check.

A specific on-site location was chosen to perform the function range check, daily background and daily function checks for the Ludlum 2221 with 44-10 used for gamma radiation levels at the site to minimize differences in readings due to background radiation.

Figure B1-1 Check Location for Ludlum 2221

Note: Picture was taken in May 2012 (This location used in October 2012 during RWPR Remediation).

The source used for checking the 2×2 NaI gamma probe and meter was a Ra-226 Quivira soil standard source in a Marinelli beaker geometry (30.3pCi/gram). Additionally, the sources used for checking the alpha meters were Th-230 button sources, traceable to the National Institute of Standards and Technology (NIST). Details on these check sources are available from Rio Algom Mining LLC.

Table B1-1 Portable Radiation Instruments Available for RWPR Remediation

Instrument		Detector		Calibration Date
Manufacturer & Model	**Serial Number**	**Manufacturer & Model**	**Serial Number**	
Gamma Meters				
Ludlum 2221	163691	Ludlum 44-10	PR276612	10 February 2012
Ludlum 2221	97837	Ludlum 44-10	PR013814	26 September 2012
Alpha Meters				
Ludlum 4	156707	Ludlum 43-5	PR156707	16 February 2012
Ludlum 4[1]	172078	Ludlum 43-5	PR220802	30 November 2011
Ludlum 2241	150711	Ludlum 43-10	PR087468	26 September 2012
Ludlum 2241[1]	149393	Ludlum 43-10	PR066834	26 September 2012

[1] Instrument was a backup and was never used therefore no daily checks performed

APPENDIX B2: SOIL SAMPLING AND FIELD GAMMA RADIATION OVERVIEW

This appendix contains the results for soil sampling for confirmation of clean-up and the borrow materials. A description of the external gamma radiation collected is provided.

B2.1 Radiological Sampling of Soil and Borrow Materials

B2.1.1 Individual Sample Results

The EPA imposed specific criteria under the UAO. The background for the RWPR Area may be higher than the UAO imposition of 1.0pCi/g. Furthermore, the imposition of an allowable increment of 1.24pCi/g is likely not appropriate for the exposure conditions on the RWPR. Confirmatory soil samples were collected from the remediated RWPR Area to confirm the assessment by gamma radiation measurements that the Area met the UAO imposed criteria of 2.24pCi/g average for the survey unit. Samples were also collected from imported off-site borrow sites to verify that the materials did not exceed the UAO imposed levels.

Plate B2-1 shows the random soil sampling locations that were identified for the two survey units south of the Unnamed Arroyo #2 Bridge. Soil measurements were completed for 15 samples in the southern unit, and 13 samples from the survey unit near the Unnamed Arroyo #2 bridge. Sample RWU2-015 was not collected as this was from an area that was not remediated to protect the bridge integrity. One sample, RWU2-006, was lost prior to shipping to the laboratory. A five-spot composite sample of the 0 to 6 inch layer was collected from selected 10 m by 10 m blocks from the center sample plus four locations 1 meter inside each of the corners as per the approved Work Plan (SENES, 2012).

Table B2-1 shows the individual Ra-226 concentrations measured using EPA Method 901.1 for the samples and includes field samples, field duplicates and laboratory splits. Table B2-2 shows the individual measurements of borrow materials considered. The borrow materials were measured for uranium and thorium concentrations in addition to Ra-226 concentrations in addition to Ra-226.

Plate B2-1 Confirmatory Soil Sample Locations

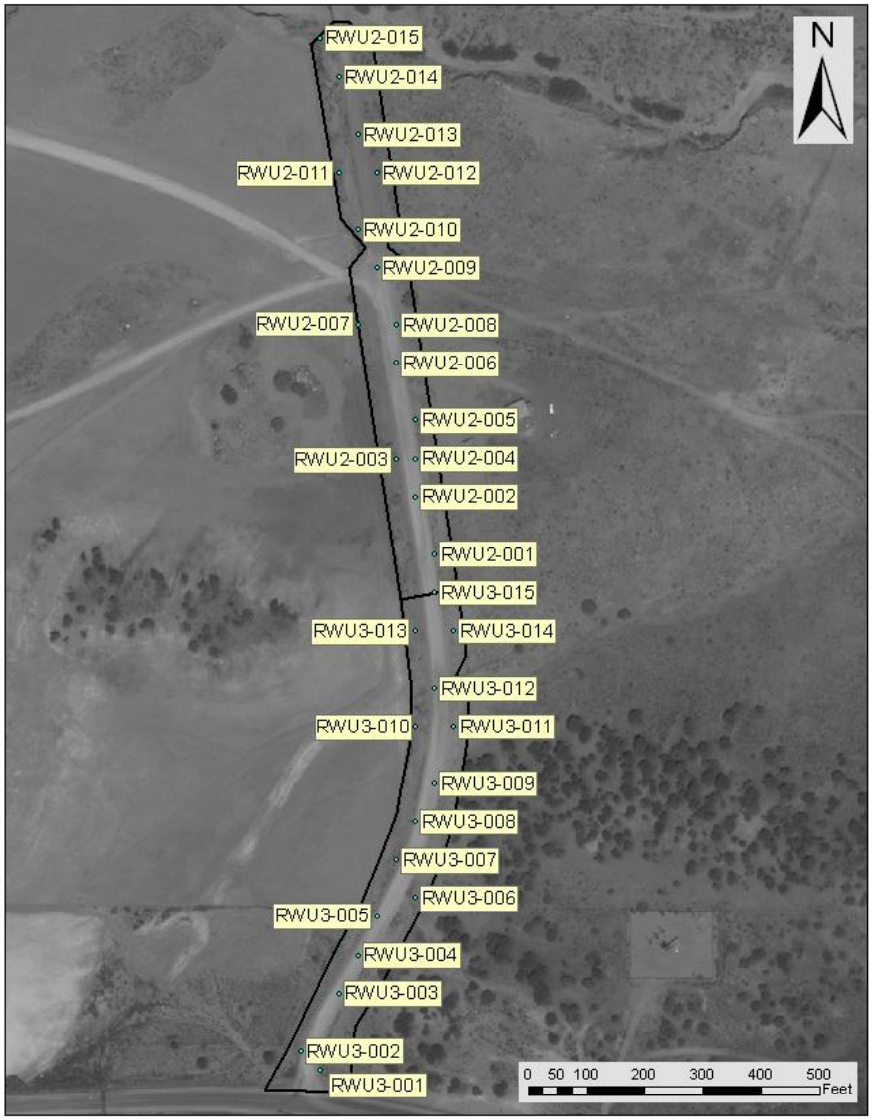


Table B2-1 Survey Unit Soil Sampling Results

RAML Sample ID	Location	Northing	Easting	Depth from surface - Top	Depth from surface - Bottom	Depth Units (inches or feet)	Identifier A=Alternate; D=Duplicate; DL=Dup Lab; R=Refusal; Q=QA Repeat	Work Order Number	ALS Sample ID	Matrix	Type	Date of Sample	Time	Ra-226 (pCi/g)
RWU2-001	RWU2	1769365	2517165	0	6	inches	DL	1211078	1211078-3	SOIL	Grab	01/11/2012	5:55:00 PM	1.13
RWU2-001	RWU2	1769365	2517165	0	6	inches		1211078	1211078-3	SOIL	Grab	01/11/2012	5:55:00 PM	1.28
RWU2-002	RWU2	1769355	2517195	0	6	inches		1211078	1211078-2	SOIL	Grab	01/11/2012	5:38:00 PM	1.73
RWU2-003	RWU2	1769345	2517215	0	6	inches		1211078	1211078-6	SOIL	Grab	02/11/2012	7:50:00 AM	2.35
RWU2-004	RWU2	1769355	2517215	0	6	inches		1211078	1211078-1	SOIL	Grab	01/11/2012	5:07:00 PM	1.99
RWU2-005	RWU2	1769355	2517235	0	6	inches	DL	1211066	1211066-18	SOIL	Grab	01/11/2012	11:46:00 AM	1.83
RWU2-005	RWU2	1769355	2517235	0	6	inches		1211066	1211066-18	SOIL	Grab	01/11/2012	11:46:00 AM	1.69
RWU2-007	RWU2	1769325	2517285	0	6	inches		1211066	1211066-14	SOIL	Grab	01/11/2012	10:13:00 AM	0.89
RWU2-008	RWU2	1769345	2517285	0	6	inches		1211066	1211066-15	SOIL	Grab	01/11/2012	10:35:00 AM	1.26
RWU2-009	RWU2	1769335	2517315	0	6	inches		1211066	1211066-17	SOIL	Grab	01/11/2012	11:21:00 AM	1.68
RWU2-010	RWU2	1769325	2517335	0	6	inches		1211066	1211066-13	SOIL	Grab	31/10/2012	4:00:00 PM	1.31
RWU2-011	RWU2	1769315	2517365	0	6	inches		1211066	1211066-11	SOIL	Grab	31/10/2012	3:01:00 PM	1.14
RWU2-012	RWU2	1769335	2517365	0	6	inches		1211066	1211066-12	SOIL	Grab	31/10/2012	3:15:00 PM	0.86
RWU2-013	RWU2	1769325	2517385	0	6	inches		1211066	1211066-10	SOIL	Grab	31/10/2012	2:25:00 PM	1.09
RWU2-014	RWU2	1769315	2517415	0	6	inches		1211078	1211078-7	SOIL	Grab	02/11/2012	8:20:00 AM	0.9
RWU2-101[1]	RWU2	1769355	2517235	0	6	inches	DL	1211066	1211066-19	SOIL	Grab	01/11/2012	12:15:00 PM	1.75
RWU2-101[1]	RWU2	1769355	2517235	0	6	inches	D	1211066	1211066-19	SOIL	Grab	01/11/2012	12:15:00 PM	2.01
RWU2-102[2]	RWU2	1769345	2517285	0	6	inches	D	1211066	1211066-16	SOIL	Grab	01/11/2012	10:51:00 AM	1.04
RWU3-001	RWU3	1769305	2516895	0	6	inches		1211066	1211066-8	SOIL	Grab	30/10/2012	11:13:00 AM	1.75
RWU3-002	RWU3	1769295	2516905	0	6	inches		1211078	1211078-9	SOIL	Grab	02/11/2012	12:55:00 PM	1.17
RWU3-003	RWU3	1769315	2516935	0	6	inches		1211066	1211066-9	SOIL	Grab	30/10/2012	11:47:00 AM	1.32
RWU3-004	RWU3	1769325	2516955	0	6	inches		1211078	1211078-10	SOIL	Grab	02/11/2012	1:10:00 PM	1.38
RWU3-005	RWU3	1769335	2516975	0	6	inches		1211078	1211078-11	SOIL	Grab	02/11/2012	1:30:00 PM	1.45
RWU3-006	RWU3	1769355	2516985	0	6	inches		1211066	1211066-7	SOIL	Grab	25/10/2012	3:32:00 PM	1.62
RWU3-007	RWU3	1769345	2517005	0	6	inches		1211078	1211078-12	SOIL	Grab	02/11/2012	4:47:00 PM	1.73
RWU3-008	RWU3	1769355	2517025	0	6	inches		1211066	1211066-1	SOIL	Grab	02/11/2012	1:30:00 PM	1.79
RWU3-009	RWU3	1769365	2517045	0	6	inches		1211066	1211066-6	SOIL	Grab	02/11/2012	3:00:00 PM	1.37
RWU3-010	RWU3	1769355	2517075	0	6	inches		1211066	1211066-4	SOIL	Grab	02/11/2012	2:15:00 PM	1.2
RWU3-011	RWU3	1769375	2517075	0	6	inches		1211066	1211066-3	SOIL	Grab	02/11/2012	1:47:00 PM	1.28
RWU3-012	RWU3	1769365	2517095	0	6	inches		1211066	1211066-5	SOIL	Grab	02/11/2012	2:32:00 PM	1.17
RWU3-013	RWU3	1769355	2517125	0	6	inches		1211078	1211078-8	SOIL	Grab	02/11/2012	9:31:00 AM	2
RWU3-014	RWU3	1769375	2517125	0	6	inches	DL	1211078	1211078-5	SOIL	Grab	01/11/2012	6:15:00 PM	0.88
RWU3-014	RWU3	1769375	2517125	0	6	inches		1211078	1211078-5	SOIL	Grab	01/11/2012	6:15:00 PM	1.11
RWU3-015	RWU3	1769365	2517145	0	6	inches		1211078	1211078-4	SOIL	Grab	01/11/2012	6:05:00 PM	1.19
RWU3-101[3]	RWU3	1769335	2516975	0	6	inches	D	1211078	1211078-13	SOIL	Grab	02/11/2012	5:15:00 PM	1.6
RWU3-102[4]	RWU3	1769355	2517025	0	6	inches	D	1211066	1211066-2	SOIL	Grab	02/11/2012	1:35:00 PM	1.49

Number Samples > 2.24 pCi/g 1

Flags

G: Sample density differs by more than 15% of Laboratory Control Spike (LCS) density

LT: Result is less than requested MDC, greater than sample specific MDC

M3: The requested MDC was not met, but the reported activity is greater than the reported MDC

P: Passed

U: Result is less than the sample specific MDC.

Notes

1. RWU2-101 is a duplicate sample for RWU2-005
2. RWU2-102 is a duplicate sample for RWU2-008
3. RWU3-101 is a duplicate sample for RWU2-005
4. RWU3-102 is a duplicate sample for RWU3-008

Table B2-2 Borrow/Backfill Sampling Results

RAML Sample ID	Identifier A=Alternate; D=Duplicate; DL=Dup Lab; R=Refusal; Q=QA Repeat	Work Order Number	ALS Sample ID	Matrix	Type	Date of Sample	Time	Uranium (ug/kg)	Thorium (ug/kg)	Ra-226 (pCi/g)
SC-VHCC-001		1209098	1209098-1	Soil	Grab	9/6/2012	1:25:00 PM	560	14000	1.33
SC-VHCC-002		1209098	1209098-2	Soil	Grab	9/6/2012	1:28:00 PM	650	15000	1.33
SC-VHCC-003		1209098	1209098-3	Soil	Grab	9/6/2012	1:33:00 PM	780	20000	1.92
SC-VHCC-004		1209098	1209098-4	Soil	Grab	9/6/2012	1:39:00 PM	800	21000	1.48
SC-VHCC-005		1209098	1209098-5	Soil	Grab	9/6/2012	1:45:00 PM	940	23000	1.96
SC-East Pit-001		1209099	1209099-1	Soil	Grab	9/6/2012	11:30:00 AM	620	2300	0.8
SC-East Pit-002	DL	1209099	1209099-2	Soil	Grab	9/6/2012	11:36:00 AM	--	--	0.46
SC-East Pit-002		1209099	1209099-2	Soil	Grab	9/6/2012	11:36:00 AM	210	1300	0.56
SC-East Pit-003		1209099	1209099-3	Soil	Grab	9/6/2012	11:50:00 AM	210	1600	0.36
SC-East Pit-004	DL	1209099	1209099-4	Soil	Grab	9/6/2012	11:58:00 AM	--	--	0.82
SC-East Pit-004		1209099	1209099-4	Soil	Grab	9/6/2012	11:58:00 AM	370	2200	0.9
SC-East Pit-005		1209099	1209099-5	Soil	Grab	9/6/2012	12:03:00 PM	250	1900	0.6
SC-East Pit-006		1209099	1209099-6	Soil	Grab	9/6/2012	12:11:00 PM	290	2400	0.78
SC-East Pit-007		1209099	1209099-7	Soil	Grab	9/6/2012	12:20:00 PM	230	1900	0.79
SC-East Pit-008		1209099	1209099-8	Soil	Grab	9/6/2012	12:28:00 PM	290	2200	0.63
SC-East Pit-009		1209099	1209099-9	Soil	Grab	9/6/2012	12:35:00 PM	240	1900	0.64
SC-East Pit-010		1209099	1209099-10	Soil	Grab	9/6/2012	12:45:00 PM	210	1500	0.3
1-ERM		1209350	1209350-1	Soil	Grab	9/18/2012	10:04:00 AM	1500	7400	1.69
2-ERM		1209350	1209350-2	Soil	Grab	9/18/2012	10:09:00 AM	690	5800	1.03
3-ERM		1209350	1209350-3	Soil	Grab	9/18/2012	10:15:00 AM	650	5400	1.34
4-ERM	DL	1209350	1209350-4	Soil	Grab	9/18/2012	10:23:00 AM	--	--	2.03
4-ERM		1209350	1209350-4	Soil	Grab	9/18/2012	10:23:00 AM	1000	6800	1.68
5-ERM		1209350	1209350-5	Soil	Grab	9/18/2012	10:27:00 AM	1100	8200	1.01
1-GSG		1209350	1209350-6	Soil	Grab	9/18/2012	12:06:00 PM	860	950	0.55
2-GSG		1209350	1209350-7	Soil	Grab	9/18/2012	12:11:00 PM	920	800	0.76
3-GSG		1209350	1209350-8	Soil	Grab	9/18/2012	12:15:00 PM	850	870	0.61
4-GSG		1209350	1209350-9	Soil	Grab	9/18/2012	12:18:00 PM	950	840	0.69
5-GSG		1209350	1209350-10	Soil	Grab	9/18/2012	12:28:00 PM	690	720	0.54
001-GSG-1inch	DL	1210098	1210098-1	Soil	Grab	10/5/2012	11:15:00 AM	--	--	0.76
001-GSG-1inch		1210098	1210098-1	Soil	Grab	10/5/2012	11:15:00 AM	--	--	0.56
002-GSG-RB		1210098	1210098-2	Soil	Grab	10/5/2012	11:22:00 AM	--	--	1
003-GSG-RB		1210098	1210098-3	Soil	Grab	10/5/2012	11:25:00 AM	--	--	0.7

Flags
G: Sample density differs by more than 15% of Laboratory Control Spike (LCS) density
LT: Result is less than requested MDC, greater than sample specific MDC
M3: The requested MDC was not met, but the reported activity is greater than the reported MDC
P: Passed
U: Result is less than the sample specific MDC.

B2.1.2 QA/QC Analyses of Replicates

Field splits were created at a sub-sample of locations and submitted for laboratory analyses. The relative percent difference (RPD) is intended to show agreement in replicate or split samples and is the ratio of the absolute difference between two measurements and their average expressed as a percent. Good agreement is an RPD of 20% or less for measurements with individual precisions of less than 20% since the random probability that the two measurements are at the opposite extremes (i.e. one reading higher and the other reading lower than the actual concentration) would be small. The equation is:

$$RPD = \frac{abs(C_1 - C_2)}{\frac{C_1 + C_2}{2}} * 100$$

where:

RPD is the relative percent difference in %

C_1 and C_2 are concentration measurements, and *abs* (C_1-C_2) is the absolute value of the difference

A comparison of the four field duplicates and the four laboratory splits is provided in Table B2-3. There is good agreement in these samples which in some cases are only about a factor of two higher than the minimum detectable concentrations (MDCS) of about 0.5pCi/g Ra-226. Only one laboratory duplicate had an RPD that slightly exceeded 20%.

Table B2-3 QA of Replicate Measurements of Ra-226 (pCi/g)

	Sample (pCi/g)	Field Duplicate (pCi/g)	RPD
RWU2-005	1.69	2.01	17%
RWU2-008	1.26	1.04	19%
RWU3-005	1.45	1.6	10%
RWU3-008	1.79	1.49	18%
	Submitted	Lab Split	
RWU2-001	1.28	1.13	12%
RWU2-005	1.69	1.83	8%
RWU2-101	2.01	1.75	14%
RWU3-014	1.11	0.88	23%

B2.1.3 Summary Tables of Soil Measurements

The RWPR confirmatory soil samples are summarized in Table B2-4 for the two survey units. With one exception, the values were well below the EPA imposed UAO 2.24pCi/g criterion. One measurement of 2.35pCi/g in RWPR-U2 slightly exceeds the criterion for the average, but this is well below 3.0pCi/g corresponding to the elevated measurement concentration (EMC) for this

project.

Table B2-4 Summary of Confirmatory Soil Measurements (pCi/g Ra-226)

Location	Number	Minimum	Median	Mean	Maximum
RWPR-U2	13	0.86	1.28	1.40	2.35
RWPR-U3	15	1.11	1.37	1.44	2.00

A summary of Ra-226 concentrations in borrow materials is provided in Table B2-5. The samples from VHCC road bed material tended to have higher Ra-226 concentrations that approached the EPA imposed clean-up criterion of 2.24pCi/g and had external gamma radiations levels higher the gamma radiation cut-off established for the remediated RPWR. These naturally occurring materials from the East Ready Mix (ERM) site were not considered suitable for use in RWPR restoration because of the UAO imposed criteria.

Table B2-5 Summary of Ra-226 Concentrations (pCi/g) in Borrow Materials

Material	Number	Mean	Minimum	Maximum
VHCC	5	1.6	1.3	2.0
ERM	4	1.4	1.0	1.7
East Pit	10	0.64	0.3	0.9
GSG	5	0.63	0.54	0.76
GSG RB	2	0.85	0.7	1
GSG 1inch	1	0.56		

The McConnel East Pit samples had Ra-226 concentrations below the background level of 1.0pCi/g contained in the UAO and this material was used as fill. The road base material used at RWPR was from Gallup Sand and Gravel (GSG) with Ra-226 concentrations at or below the 1.0pCi/g background contained in the UAO. The GSG materials were limestone based and the 1 inch granular material from this site had a similar concentration as observed in the road base material.

B2.2 External Gamma Radiation Measurements

External gamma radiation levels are collected during the remediation process to ensure that remediation was completed to the criterion established.

B2.2.1 External Gamma Radiation Methodology

A high density gamma radiation scan was conducted with the collimated 2 inch by 2 inch NaI detectors and Ludlum Model 2221 meters used during RSE activities. The detectors were located 18 inches from the ground and the survey was conducted at speeds not exceeding 1 m/s. Each morning and evening, the detectors were checked for suitable operation through

instrument and measurements of background and a source with comparison to QA/QC operating limits.

Measurements during remediation were of two types; first, the scanned areas were traversed by a regular pattern with the data reviewed in the evening to determine the completeness of the removal. An assessment against criterion was established using gamma radiation levels averaged to the 5 m by 5 m and 10 m by 10 m blocks following the flow chart in Figure 4.1 (reproduced from Workplan [SENES 2012]). Remediation required both blocks met their criterion: the process was iterative until remediation was deemed complete. Plots of the gamma radiation were created to aid in team planning for continuing remediation and specific areas requiring excavation were marked for further removal. The second approach was to conduct static measurements during breaks in equipment operation. Areas requiring further excavation were indicated at that time.

B2.2.2 Individual Measurements

Plate B2-2 shows a plot of the individual measurements collected following completion of excavation.

The data are provided electronically in the attached CD in the file named *350180-203 Individual Scanning Gamma Measurements used For Verification.CSV*. The file includes the following fields:

- Column 1 is the Eastings: NAD83 U.S. State Plane (feet) New Mexico West FITS 3003.
- Column 2 is the Northings: NAD83 U.S. State Plane (feet) New Mexico West FITS 3003.
- Column 3 is the gamma radiation collimated count rate (cpm).
- Column 4 is the date of the scanning measurement.

B2.2.3 Summary of External Gamma Radiation

Average gamma radiation levels (cpm) were determined for each 5 m by 5 m block from the individual measurements. The averages were calculated for 10 m by 10 m blocks when there were four 5 by 5 m blocks measured. There were two verification criteria in the work plan; first that a 5 m by 5 m block average would not exceed 5,580 cpm to ensure that the 5 m by 5 m block does not have a Ra-226 concentration exceeding the elevated measurement concentration of 3.0pCi/g for this remediation project. The second was that a 10 m by 10 block did not exceed 5,088 cpm to ensure that the 10 m by 10 m block was below the EPA imposed UAO 2.24pCi/g Ra-226 criterion.

Table B2-6 shows the summary statistics of the scanning gamma radiation measurements used for verification. All blocks within the remediated area met the field verification criteria

Plate B2-2 Individual Gamma Radiation Count Rates Following Remediation

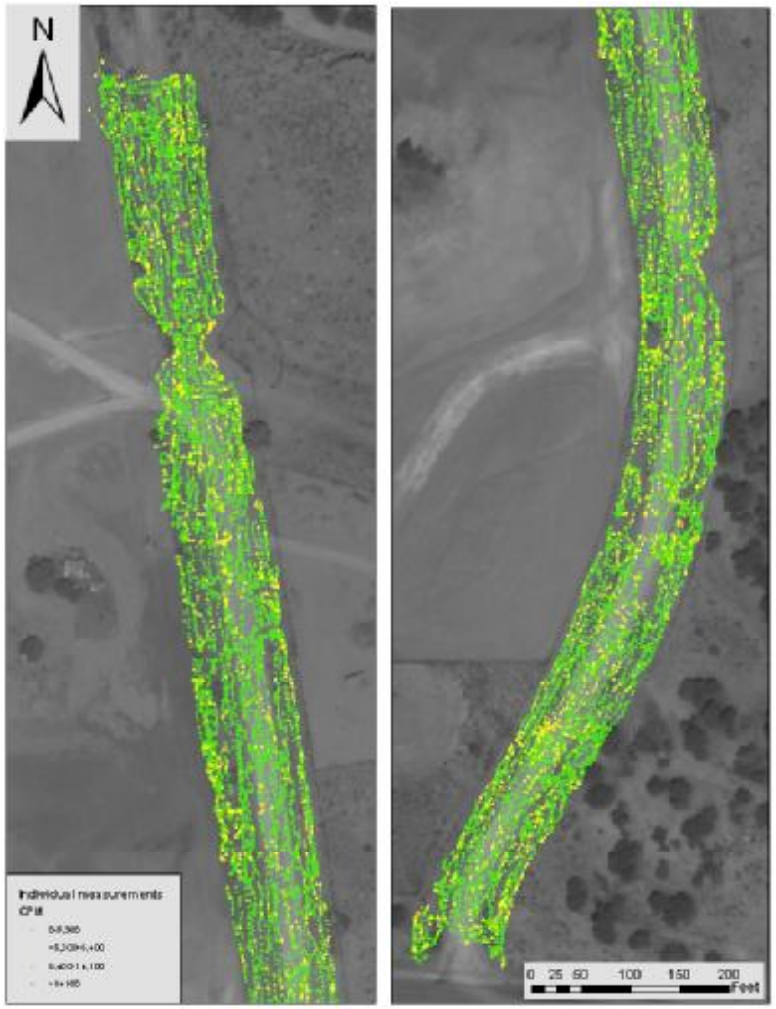


Table B2-6 Summary of Gamma Radiation Measurements (cpm) by Block

	Number	Minimum	Mean	Maximum
5 m block	684	3917	4821	5578
10 m block	141	4266	4809	5081

APPENDIX B3: VERIFICATION TEST RESULTS

The following section describes the environmental testing that was conducted to ensure that the remedial measures that were taken complied with the UAO.

B3.1 ENVIRONMENTAL MONITORING AND TESTING

Environmental monitoring and testing was conducted during the program to confirm that all EPA UAO criteria were met.

B3.1.1 SAMPLING RATIONALE AND OBJECTIVES

A sampling program for verification was proposed and accepted by EPA for the confirmation that excavation met the EPA imposed UAO criterion of 2.24pCi/g Ra-226 over a 6 inch soil depth horizon (SENES 2012). The sampling rationale and objectives for confirmation of remediation included field verification based on field measurements of surface gamma radiation that could be correlated with soil Ra-226 concentrations. Gamma radiation measurements during the excavation process were used to direct the need for additional excavation until such time as gamma radiation measurements for an excavated area met the gamma radiation criteria.

During the excavation process a high density gamma radiation scan was conducted following excavation of various areas and these areas were considered to meet criterion if the average gamma radiation levels was statistically significantly below the clean-up criteria. Following field verification by gamma radiation, soil samples were collected from the 0 to 6 inch soil horizon for laboratory analyses of Ra-226 concentrations for reporting purposes to show that the clean-up had met the AOC criterion.

Three survey units had been determined in the work plan with two survey units located south of Unnamed Arroyo No. 2 bridge where the UAO required actions and a survey area north of the bridge. Although a survey area north of the bridge was contained in the work plan, the UAO did not require any action to the north of the bridge and so no surveys were taken north of the bridge. However, a gamma radiation survey was conducted of this area following excavation and these results are reported separately.

EPA agreed that no excavation works were to be carried out in the immediate vicinity south of the RWPR bridge over the Unnamed Arroyo #2 to ensure the integrity of the bridge structure and surrounding soils. This resulted in a reduced number of samples for this survey unit as one sample had been assigned to this area prior to the field decision being made.

Additional environmental monitoring including high volume sampling of ambient air uranium and Ra-226 concentrations, worker breathing zone samples and radiation exposures. These programs are described in Appendix E and indicated conditions well below regulatory requirements.

B3.1.2 Quality Control Program

Quality control programs for radiation monitoring program were conducted throughout the construction period. This included daily checks of gamma radiation monitoring equipment operation along with replicate soil sampling and validation and verification of sample measurements. These results are provided in Appendix B.

B3.1.3 Field Radiation Survey Results

External gamma radiation measurements were collected with a high density gamma radiation scan program using automated collection of GPS coordinates and gamma radiation measurements. These measurements indicated that the remediated RWPR Area met the EPA imposed UAO criterion of 2.24pCi/g Ra-226 and the elevated measurement concentration of 3.0pCi/g based on averaging of the gamma radiation measurements as described in the approved sampling plan. Composite soil samples were collected from the 0 to 6 inch soil horizon and these demonstrated that the remediated area met the criterion.

B3.1.3.1 Confirmatory Surveys

Relationships between gamma radiation count rate and soil Ra-226 concentration were developed from previous characterization of the site [RSE 2011] so that Ra-226 concentrations were predicted by the gamma radiation levels. Gamma radiation measurements were used to direct the excavation process and, following complete excavation, provided field verification that the UAO criterion was met.

B3.1.3.2 Summary of Procedure

Field gamma radiation measurements were collected during the excavation process by high density scans or through static scans. The static scans provided real-time identification of areas requiring further removal while equipment in the work area was temporarily shut-down. Daily review of the high density scans identified whether areas met the UAO criterion and areas requiring additional excavation were identified.

Gamma radiation measurements were not collected within a distance of 1 meter (m) from unexcavated areas (e.g. fence lines, around hydro poles) to prevent anomalous radiation measurements due to shine introduced by the geometry present.

Individual measurements and the summary of gamma radiation levels over various averaging areas are discussed in Appendix B.

B3.1.3.3 External Gamma Radiation Verification

Following completion of excavation, an assessment against criterion was established using gamma radiation levels averaged to the 5 m by 5 m and 10 m by 10 m blocks following the flow chart in Figure B3-1 (reproduced from Workplan [SENES 2012]). Remediation required both blocks met their criterion: the process was iterative until remediation was deemed complete.

The sampling plan determined that an average gamma radiation of 5,088 cpm over a 10 m by 10 m block had less than a 2.5% probability of exceeding the EPA imposed UAO 2.24pCi/g Ra-226 criterion. Each 5 m by 5 m block will pass criterion if the average gamma radiation level is below 5,580 cpm to ensure that the concentration is below the elevated measurement concentration (EMC) of 3.0pCi/g Ra-226. MARSSIM approach ensures that the average concentration in survey units meets the criterion but allows some samples to slightly exceed the criterion, up to the EMC, without resulting in elevated dose.

Plate B3-1 shows the comparison of 10 m by 10 m and 5 m by 5 m blocks against the relevant criteria. All of the blocks meet their gamma radiation criteria and therefore the field gamma radiation survey verified that excavation remedial works had met the UAO criterion.

B3.1.3.4 Confirmatory Soil Sampling Results

The gamma radiation scanning program verified that the remedial excavation work was completed to the prescribed EPA imposed UAO criterion of 2.24pCi/g.

For final reporting purposes, a soil sampling program was conducted to confirm that the soil criterion was met. The MARSSIM Wilcoxon test indicated that the two survey units below the Unnamed Arroyo #2 bridge met the UAO criterion and the assessment using gamma radiation was confirmed.

Figure B3-1 Logic for Field Verification Assessment Using Gamma Radiation Measurements

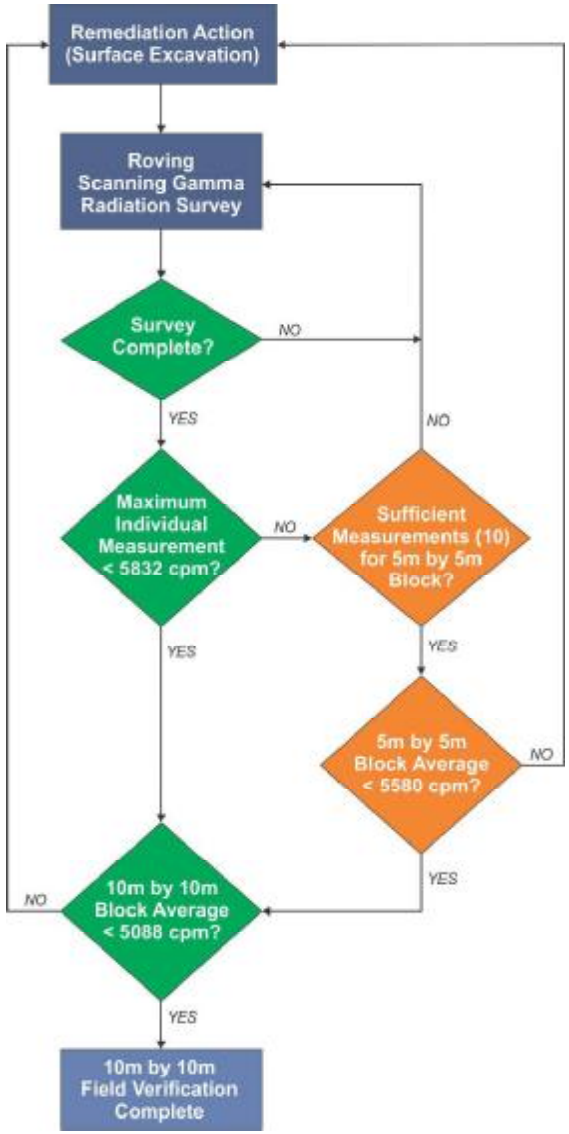
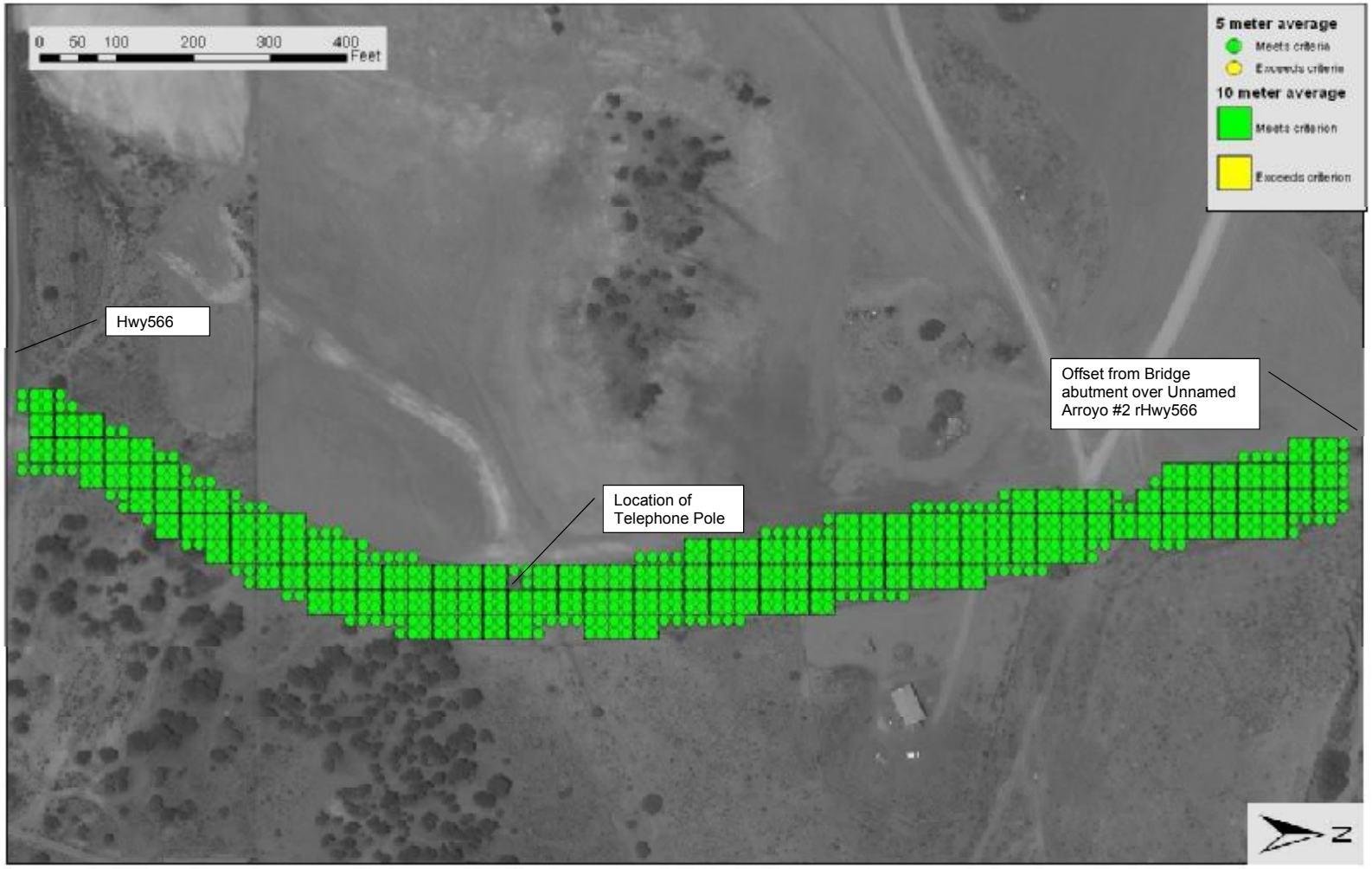


Plate B3-1 Results of Field Verification by Gamma Radiation Measurement



B3.1.3.5 Soil Sampling Locations

Soil sampling locations were specified for the two survey units south of the Unnamed Arroyo #2 bridge with an intended number of fifteen (15) samples per survey unit. A five-spot composite sample of the 0 to 6 inch layer was collected from selected 10 m by 10 m blocks from the center sample plus four locations 1 meter inside each of the corners. At each of the five locations, a grab sample of about 2 pounds was collected from the top 0 to 6 inch soil horizon and was placed in a stainless steel mixing pole. Many samples had variation in the type of soil ranging from sandy materials, to loose shales to soils with a high silt content.

Following collection of the five sub-samples, the soil was mixed and the composite sample was mixed for submission to laboratory analyses. These samples submitted for laboratory analyses using EPA 901.1 as was used in the RSE (SENES 2011b). Individual sample locations, reported results and a comparison of field replicates are included in Appendix E.

B3.1.3.6 Measurement Results

Table B3-1 summarizes the confirmatory measurements in the two survey units. The mean measured concentrations of 1.40 and 1.44pCi/g for the RWPR-U2 and RWPR-U3 are well below the EPA imposed UAO criterion of 2.24pCi/g. There is, however, one measurement of 2.35pCi/g in RWPR-U2 that slightly exceeds the criterion for the average, but this is well below 3.0pCi/g corresponding to the elevated measurement concentration (EMC) for this project.

Table B3-1 Summary of Confirmatory Soil Measurements (pCi/g Ra-226)

Location	Number	Minimum	Median	Mean	Maximum
RWPR-U2	13	0.86	1.28	1.40	2.35
RWPR-U3	15	1.11	1.37	1.44	2.00

B3.1.4 Assessment

The MARSSIM decision rule was used to confirm that the survey average mean concentration did not exceed the UAO criteria of 2.24pCi/g. Since the contaminant is present in background, the statistical test used was the Wilcoxon test. The null hypothesis was that the survey unit exceeds the criterion and an acceptable alpha error of 0.05 was used.

The adjusted background data were calculated by adding the Derived Concentration Guideline Level (DCGL) of 1.24pCi/g (specified in AOC EPA Appendix C, Scope of Work for AOC, Item 10 Preliminary Action Level) to each of the background (reference) measurements. The Wilcoxon test, as applied using statistical software, (PROC NPAR1WAY in SAS), determined that the probability that either survey unit exceeds the adjusted background data had very low probability ($P < 0.0001$) and therefore the null hypotheses that the survey units exceed criterion were rejected for the RWPR south of Unnamed Arroyo #2. The conclusion is that the survey units meet the criterion. The finding was also confirmed using MARSSIM methodology. Table 3.1-2 shows the sum of the ranks for survey and adjusted background and the test

statistics calculated using equation I.1 from MARSSIM. The adjusted background ranks exceed the test statistic for both units therefore the hypothesis is rejected using the MARSSIM terminology and presentation.

Table 3.1-2 Wilcoxon Test for Confirmatory Soil Samples

	Sum of Ranks		
	Survey	**Background**	**Test Statistic**
RWPR-U2	111	630	541
RWPR-U3	122	698	571

Note:
Test statistic for the survey unit with 0.05 alpha error as calculated using MARSSIM methodology.

The soil samples confirm that the two survey units of RWPR between Highway 566 and the Unnamed Arroyo #2 bridge have been cleaned up to criterion level as the null hypothesis has been rejected.

Handheld Radiation Meter Calibrations and QA Checks

RIO ALGOM MINING LLC
Function Check Range Worksheet

Technician Ken Stager Date Oct 15 2012

Instrument: Model Ludlum 2221 S/N 163691
Probe 44-10 s/n 276612

Source: S/N 119630 Isotope and Activity Ra 226 303 pCi/g
Standard #3

Observation	Observed Reading (counts or cpm)	
1	5589	22487
2	5810	22143
3	5701	22593
4	5735	22805
5	5556	22583
6	5799	22645
7	5745	22873
8	5649	22498
9	5759	22811
10	5811	22475
Total	57154	225913
Average	5715	22591

Operating range set at 20% of average as Per. Reg. Guide 8.30

To establish lower end of range: average – 20% of average
To establish upper end of range: average + 20% of average

	Low	High
Background	4572	6858
Operating Range Source	18073	27110

Comments:

Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Scaler/Ratemeter ID: _Ludlum 2221 S/N 163691_____Function Check Source: Soil Source Beaker

2" x 2" Detector ID: _Ludlum 44-10 S/N 276612_____ Acceptable Background Count Rate (cpm) Range (+/- 20%) ___4572__ to ___6858_____
Acceptable Source Count Rate (cpm) Range (+/- 20%) _____18073___ to __27110_____

Date ( )	Physical Check	Cal Due Date	Battery ( ) (V)	High Voltage (V)	Threshold ( )	Window IN or OUT ( )	Background Counts (cpm)	Source Counts (cpm)	Within Acceptable Range Y or N	MDC (pCi/g)
Oct 29 AM	SAT	10 Feb 2013	5.8	1051		OUT	5927	23104	Y	
Oct 29 PM	SAT	10 Feb 2013	5.7	1047		OUT	5431	22345	Y	
Oct 30 AM	SAT	10 Feb 2013	5.8	1055		OUT	5671	23679	Y	
Oct 30 PM	SAT	10 Feb 2013	5.6	1050		OUT	5756	23679	Y	
Oct 31 AM	SAT	10 Feb 2013	5.7	1053		OUT	5886	22974	Y	
Oct 31 PM	SAT	10 Feb 2013	5.7	1047		OUT	5304	22191	Y	
Nov 1 AM	SAT	10 Feb 2013	5.7	1053		OUT	5673	22768	Y	
Nov 1 PM	SAT	10 Feb 2013	5.7	1050		OUT	5552	22505	Y	
Nov 2 AM	SAT	10 Feb 2013	5.7	1055		OUT	5674	23030	Y	

Note: (1) Battery Voltage for Ludlum 2221 must b5.9e >4.4 volts1064; (2) Threshold must be at 100 (= 10 mV); (3) Window Position must be OUT

RIO ALGOM MINING LLC
Function Check Range Worksheet

Technician Ron Steger Date 16th Oct 15 2012

Instrument: Model Ludlum 2221 S/N 97837
Probe 43-10

Source: S/N 1196030 Isotope and Activity Ra-226 30.3 pc/g
Standard #3

Observation	Observed Reading (counts or cpm) Background	Source
1	5479	23306
2	5500	23111
3	5329	23120
4	5840	23169
5	5402	23124
6	5307	23088
7	5361	23048
8	5371	23143
9	5310	23085
10	5423	23080
Total	53722	231364
Average	5372	23136

Operating range set at 20% of average as Per. Reg. Guide 8.30

To establish lower end of range: average – 20% of average
To establish upper end of range: average + 20% of average

	Low		High
Operating Range Background	4298	–	6447
Source	18509		27764

Comments:

Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Scaler/Ratemeter ID: _Ludlum 2221 S/N 97837_____Function Check Source: Soil Source Beaker

2" x 2" Detector ID: _Ludlum 44-10 S/N PR013814_____ Acceptable Background Count Rate (cpm) Range (+/- 20%) ___4298__ to ___6447_____
Acceptable Source Count Rate (cpm) Range (+/- 20%) _____18509___ to __277614_____

Date ( )	Physical Check	Cal Due Date	Battery ( ) (V)	High Voltage (V)	Threshold ( )	Window IN or OUT ( )	Background Counts (cpm)	Source Counts (cpm)	Within Acceptable Range Y or N	MDC (pCi/g)
Oct 16 AM	SAT	Sept 26, 2013	5.7	1053		OUT	5655	24398	Y	
Oct 16 PM	SAT	Sept 26, 2013	5.6	1049		OUT	5426	23449	Y	
Oct 17 AM	SAT	Sept 26, 2013	5.7	1053		OUT	5765	24560	Y	
Oct 17 PM	SAT	Sept 26, 2013	5.5	1050		OUT	5406	23324	Y	
Oct 18 AM	SAT	Sept 26, 2013	5.5	1055		OUT	5830	24101	Y	
Oct 18 PM	SAT	Sept 26, 2013	5.5	1046		OUT	5409	22850	Y	
Oct 23 AM	SAT	Sept 26, 2013	6.3	1052		OUT	5379	23886	Y	
Oct 23 PM	SAT	Sept 26, 2013	6.0	1050		OUT	5573	22885	Y	
Oct 24 AM	SAT	Sept 26, 2013	6.1	1055		OUT	5435	23030	Y	
Oct 24 PM	SAT	Sept 26, 2013	5.9	1054		OUT	5636	22993	Y	
Oct 25 AM	SAT	Sept 26, 2013	5.9	1051		OUT	5412	23634	Y	
Oct 25 PM	SAT	Sept 26, 2013	5.9	1056		OUT	5669	23142	Y	

Note: (1) Battery Voltage for Ludlum 2221 must b5.9e >4.4 volts1064; (2) Threshold must be at 100 (= 10 mV); (3) Window Position must be OUT

Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Scaler/Ratemeter ID: _Ludlum 2221 S/N 97837_____Function Check Source: Soil Source Beaker

2" x 2" Detector ID: _Ludlum 44-10 S/N PR013814_____ Acceptable Background Count Rate (cpm) Range (+/- 20%) ___4298__ to ___6447_____
Acceptable Source Count Rate (cpm) Range (+/- 20%) _____18509___ to __277614_____

Date ( )	Physical Check	Cal Due Date	Battery ( ) (V)	High Voltage (V)	Threshold ( )	Window IN or OUT ( )	Background Counts (cpm)	Source Counts (cpm)	Within Acceptable Range Y or N	MDC (pCi/g)
Oct 26 AM	SAT	Sept 26, 2013	5.9	1064		OUT	5472	23128	Y	
Oct 26 PM	SAT	Sept 26, 2013	5.9	1055		OUT	5481	22850	Y	
Oct 27 AM	SAT	Sept 26, 2013	5.9	1062		OUT	5585	24029	Y	
Oct 27 PM	SAT	Sept 26, 2013	5.8	1059		OUT	5674	23280	Y	
Oct 29 AM	SAT	Sept 26, 2013	5.7	1061		OUT	6130	24088	Y	
Oct 29 PM	SAT	Sept 26, 2013	5.7	1051		OUT	5355	23211	Y	
Oct 30 AM	SAT	Sept 26, 2013	5.8	1060		OUT	5595	23999	Y	
Oct 30 PM	SAT	Sept 26, 2013	5.8	1053		OUT	5448	23524	Y	
Oct 31 AM	SAT	Sept 26, 2013	5.8	1057		OUT	5508	23822	Y	
Oct 31 PM	SAT	Sept 26, 2013	5.7	1055		OUT	5653	23339	Y	
Nov1 AM	SAT	Sept 26, 2013	5.8	1060		OUT	5798	24087	Y	
Nov 1 PM	SAT	Sept 26, 2013	5.7	1058		OUT	5511	23136	Y	
Nov 2 AM	SAT	Sept 26, 2013	5.7	1058		OUT	5522	22505	Y	

Note: (1) Battery Voltage for Ludlum 2221 must be >4.4 volts; (2) Threshold must be at 100 (= 10 mV); (3) Window Position must be OUT

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RIO ALGOM MINING LLC ORDER NO. 20193576/373530

Mfg. Ludlum Measurements, Inc. Model 4 Serial No. 156707

Mfg. Ludlum Measurements, Inc. Model 43-5 Serial No. PR156707

Cal. Date 16-Feb-12 Cal Due Date 16-Feb-13 Cal. Interval 1 Year Meterface 202-558

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Atl 720.6 mm Hg

☐ New Instrument Instrument Received: ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 600 V Input Sens. 32 mV Det. Oper. 600 V at 32 mV Threshold Dial Ratio = mV

☐ HV Readout (2 points) Ref./Inst. 500 / 505 V Ref./Inst. 2000 / 2015 V

COMMENTS:
Cal'd with DTC in OFF position.
DR checked but not set.
Th230 ≈510dpm check source SN:10546 reads ≈60cpm with 43-5 placed against source.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X1000	400kcpm	380	400
X1000	100kcpm	95	100
X 100	40kcpm	380	400
X 100	10kcpm	95	100
X 10	4kcpm	380	400
X 10	1kcpm	95	100
X 1	400cpm	380	400
X 1	100cpm	95	100

*Uncertainty within ± 10% C.F. within ± 20% ALL **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout				Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques e calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ 11008 ☐ 1879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N 1-304

☑ Alpha S/N PU239 SN:7053 24900dpm ☐ Beta S/N ☐ Other

☑ m 500 S/N 190566 ☐ Oscilloscope S/N ☑ Multimeter S/N 86250390

Calibrated By: [signature] Date 16-Feb-12

Reviewed By: [signature] Date 16 Feb 12

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

RIO ALGOM MINING LLC
Function Check Range Worksheet

Technician Darrell Liles Date 10/6/2012

Instrument: Model Ludlum 4 S/N 156707
Probe: 43-5 S/N 156907

Source: S/N 10788 Isotope and Activity Th-230 / 1585 DPM

Observation	Observed Reading (counts or cpm)
1	200
2	170
3	180
4	210
5	200
6	190
7	220
8	190
9	170
10	190
Total	1920
Average	192

Operating range set at 20% of average as Per. Reg. Guide 8.30

To establish lower end of range: average – 20% of average
To establish upper end of range: average + 20% of average

Operating Range 154 - 230

Comments:

RIO ALGOM MINING LLC/CHURCHROCK
INSTRUMENT FUNCTION CHECK FORM

Instrument Ludlum 4 Serial # 156707 Probe 43-5 156707

Source S/N 10788 Cal. Date 2/16/2012 Eff. _____

DATE	CHECKED BY	READING COUNT/3	CALIBRATION RANGE	OK? Y/N	COMMENTS
10/6/2012	Liles	190	154-230	Y	
10/8/2012	Liles	210	154-230	Y	
10/9/2012	Liles	220	154-230	Y	
10/10/2012	Liles	200	154-230	Y	
10/11/2012	Liles	190 ~~180~~	154-230	Y	
10/12/2012	Liles	220	154-230	Y	
10/13/2012	Liles	180	154-230	Y	
10/14/2012	Liles	190	154-230	Y	
10/15/2012	Liles	180	154-230	Y	
10/16/2012	Liles	190	154-230	Y	
10/17/2012	Liles	180	154-230	Y	
10/18/2012	Liles	190	154-230	Y	
10/24/2012	Liles	190	154-230	Y	
10/25/2012	Liles	200	154-230	Y	
10/26/2012	Stayer	~~522~~ 200	154-230	Y	
10-29-2012	Wilson	200	151-230	Y	
11-01-2012	Stayer	200	151-230	Y	

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RIO ALGOM MINING LLC ORDER NO. 20189091/370091

Mfg. Ludlum Measurements, Inc. Model 4 Serial No. 172078

Mfg. Ludlum Measurements, Inc. Model 43-5 Serial No. PR220902

Cal. Date 30-Nov-11 Cal Due Date 30-Nov-12 Cal. Interval 1 Year Meterface 202-558

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 20 % Alt 703.6 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 750 V Input Sens. 35 mV Det. Oper. 750 V at 35 mV Threshold Dial Ratio = m³

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2000 V

COMMENTS: Calibrated with DTC switch in OFF position.
4 pi Eff. for Pu239=25,200dpm is:13.48% 4 pi Eff. for Th230=19,800dpm is:14.13%
Background:2cpm Reading: 3,400cpm Background:2cpm Reading: 2,800cpm

Gamma Calibration: GM detectors positioned perpendicular to source except for M-44-9 in which the front of probe faces source

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X100	400kcpm	400	400
X100	100kcpm	100	100
x10	40kcpm	400	400
x10	10kcpm	100	100
x1	4kcpm	400	400
x1	1kcpm	100	100
	400cpm	460	400
	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

Digital Readout: REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale: REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ro-226 S/N Y982
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ 1879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am 241 Be S/N T-304

☑ Alpha S/N Pu239:2928,Th230:E121495 ☐ Beta S/N ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93070637

Calibrated By: Jeremy Thompson Date 30-Nov-11

Reviewed By: Richard H Date 30 Nov 11

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Certificate of Calibration

Calibration and Voltage Plateau

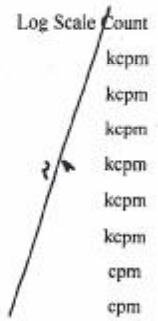
Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGinHce.com

Meter: Manufacturer: Ludlum Model Number: 2241 Serial Number: 150711

Detector: Manufacturer: Ludlum Model Number: 43-10 Serial Number: PR087468

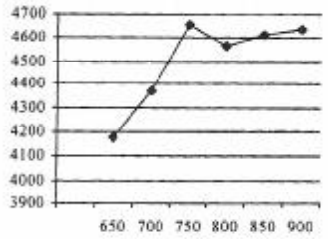
☑ Mechanical Check ☐ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☐ Contact ☐ 6 inches ☑ Other: In Planchet Cable Length: ☑ 39-inch ☐ 72-inch ☐ Other:
Source Geometry: ☐ Side ☐ Below ☑ Other: In Planchet Temperature: 74 °F Relative Humidity 20 %
Threshold: 10 mV Window: Barometric Pressure: 24.54 inches Hg
Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"		Meter Reading		Integrated 1-Min. Count	Log Scale Count
x 1000	400	399	kcpm	399	kcpm	399115	kcpm
x 1000	100	99.4	kcpm	99.4	kcpm		kcpm
x 100	400	39.9	kcpm	39.9	kcpm	39911	kcpm
x 100	100	9.9	kcpm	9.9	kcpm		kcpm
x 10	400	3.99	kcpm	3.99	kcpm	3991	kcpm
x 10	100	1.01	kcpm	1.01	kcpm		kcpm
x 1	400	398	cpm	398	cpm	399	cpm
x 1	100	99.1	cpm	99.1	cpm		cpm



High Voltage	Source Counts	Background
650	4177	3
700	4369	1
750	4658	2
800	4568	1
850	4613	0
900	4636	0

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =800

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number: ☐ 8749012
☑ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03 ☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03 ☐ Other Source:

Calibrated By: Calibration Date: 9-26-12 Calibration Due: 9-26-13

Reviewed By: Review Date: 9/26/12

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997
NMRCB Registration No. 921-3 * Calibration of Radiation Detection Instrument Devices

RIO ALGOM MINING LLC
Function Check Range Worksheet

Technician Darrell Liles Date 10/6/2017

Instrument: Probe Model Ludlum 2241 Model 43-10 S/N 150711 S/n PR087468

Source: S/N 10786 / 10788 Isotope and Activity Th-230 616 DPM / 1585 DPM

Observation	Observed Reading (counts or cpm) 10786 616 DPM	10788 1585 DPM
1	212	573
2	238	490
3	228	517
4	227	525
5	238	478
6	257	530
7	252	528
8	234	541
9	224	511
10	222	538
Total	2332	5171
Average	233	517

Operating range set at 20% of average as Per. Reg. Guide 8.30

To establish lower end of range: average – 20% of average
To establish upper end of range: average + 20% of average

10786 187-279

Operating Range # 10788 414 - 620

Comments:

RIO ALGOM MINING LLC/CHURCHROCK
INSTRUMENT FUNCTION CHECK FORM

Probe 4370
S/N PR 087468

Instrument Ludlum 2241 Serial # 150711
Source S/N 10786/10788 Cal. Date 9/26/2012 Eff.

DATE	CHECKED BY	READING COUNT/3	CALIBRATION RANGE	OK? Y/N	COMMENTS
10/6/2012	L.Les	256	187-279	Y	
10/6/2012	L.Les	525	414-620	Y	
10/10/2012	L.Les	497	414-620	Y	
10/10/2012	L.Les	246	187-279	Y	
10/11/2012	L.Les	218	187-279	Y	
10/11/2012	L.Les	523	414-620	Y	
10/12/2012	L.Les	211	187-279	Y	
10/12/2012	L.Les	501	414-620	Y	
10/13/2012	L.Les	246	187-279	Y	
10/13/2012	L.Les	505	414-620	Y	
10/15/2012	L.Les	220	187-279	Y	
10/15/2012	L.Les	519	414-620	Y	
10/16/2012	L.Les	246	187-279	Y	
~~10/16/2012~~ 10/16/2012	L.Les	~~239~~ 525	414-620	Y	
10/17/2012	L.Les	~~233~~ 527	~~187-279~~ 414-620	Y	
10/18/2012	L.Les	230	187-279	Y	
10/18/2012	L.Les	480	414-620	Y	
10/24/2012	L.Les	238	187-279	Y	
10/24/2012	L.Les	487	414-620	Y	
10/25/2012	Steger	215	187-279	Y	
10/25/2012	Steger	475	414-620	Y	
10/26/2012	Steger	252	187-279	Y	
10/26/2012	Steger	522	414-620	Y	

Certificate of Calibration

Calibration and Voltage Plateau

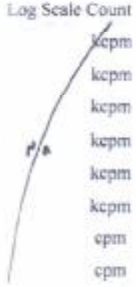
Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2241 Serial Number: ~~148089~~ 149353

Detector: Manufacturer: Ludlum Model Number: 43-10 Serial Number: PR066834

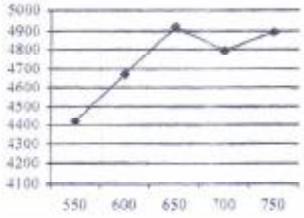
☑ Mechanical Check ☐ Geotropism ☑ THR/WIN Operation ☑ Audio Check ☑ Battery Check (Min 4.4 VDC)
☑ F/S Response Check ☑ Meter Zeroed ☑ Reset Check HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Source Distance: ☐ Contact ☐ 6 inches ☑ Other: In Planchet Cable Length: ☑ 39-inch ☐ 72-inch ☐ Other:
Source Geometry: ☐ Side ☐ Below ☑ Other: In Planchet Temperature: 73 °F Relative Humidity 20 %
Threshold: 10 mV Window: Barometric Pressure: 24.57 inches Hg
Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"		Meter Reading		Integrated 1-Min. Count	Log Scale Count
x 1000	400	399	kcpm	399	kcpm	399540	kcpm
x 1000	100	98	kcpm	98	kcpm		kcpm
x 100	400	39.9	kcpm	39.9	kcpm	39953	kcpm
x 100	100	9.8	kcpm	9.8	kcpm		kcpm
x 10	400	3.99	kcpm	3.99	kcpm	3997	kcpm
x 10	100	0.97	kcpm	0.97	kcpm		kcpm
x 1	400	398	cpm	398	cpm	400	cpm
x 1	100	100	cpm	100	cpm		cpm



High Voltage	Source Counts	Background
550	4420	0
600	4668	1
650	4915	0
700	4796	2
750	4892	1

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =650

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932 Fluke multimeter serial number: ☐ 8749012
☑ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03 ☐ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Beta Source: Sr-90 @ 17,700 dpm (1/4/12) sn: 4099-03 ☐ Other Source:

Calibrated By: Calibration Date: 9-26-12 Calibration Due: 9-26-13

Reviewed By: Review Date: 9/26/12

This calibration conforms to the requirements and applicable calibration conditions of ANSI N323A - 1997.
NMRCB Registration No. #21-3 * Calibration of Radiation Detection Instrument Devices

Air Sampler Calibration

Instructions for the Staplex Air Sampler Calibration Kit

These instructions mirror those provided by the manufacturer with changes and additions for clarity. Per manufacturer's instructions, Staplex high volume air samplers require calibration every six months or when the motor is replaced or new brushes are installed.

1. Assemble the Staplex high volume air sampler and attach the 8" X 10" filter adapter with a filter in place. It is easier to put the filter in if you loosen the top bolt completely and the side and bottom bolts as needed and insert the filter from the top.

2. Turn on the Staplex and let it run to stabilize for about 5 minutes.

3. After 5 minutes of operation and while the Staplex is running, adjust the rotometer located on the back of the Staplex to 60 cubic feet per minute (cfm). To do this, loosen the hexagon nut below the top of the screw so the screw can be adjusted. Hold the rotometer pressure gauge firmly against the back plate of the Staplex with one hand and use the other hand to slowly turn the hexagon screw until the float rises to 60 cfm. Turn the screw counterclockwise to raise the float and clockwise to lower the float. **Note:** View the rotometer straight on at eye level and use the center of the float to determine the rotometer reading. The center of the red float should read 60 cfm.

4. Once the float is adjusted, continue to hold the rotometer pressure gauge firmly against the back plate while slowly tightening the hexagon nut located directly below the screw ensuring the float continues to read 60 cfm.

5. Turn off the Staplex air sampler.

6. Remove the 8" x 10" paper holder by removing the four screws and tightly attach the 8" x 10" calibration adapter plate using the supplied screws. **Note:** Ensure the filter paper is removed before continuing calibration.

7. Attach the calibration orifice with the # 18 resistance plate in place.

8. Turn both knobs located on top of the manometer one full turn, then, connect one end of the supplied tubing to the water monometer and the other end to the orifice.

9. Turn on the Staplex sampler and after 2 minutes record the water manometer reading and the rotometer reading. **Note:** The rotometer reading is obtained by adding the inches of H_2O above zero on one side and the inches of H_2O below zero on the other side. Record the rotometer and manometer readings on the calibration worksheet.

10. Repeat the process for the remaining resistant plates. Remember to record all readings.

11. Using the following equations, convert the temperatures and pressures at which the kit was calibrated (provided in the documentation with the kit) to Standard Temperature and Pressure (STP).

STEP 1 for temperature: deg F – 32 x 5/9 = deg C (Celsius)

STEP 2 for temperature: deg C + 273 = deg K (Kelvin)

For pressure: inHg x 25.4 mm/inch = mmHg

12. Record the answers as T2 (temperature) and P2 (pressure).

13. To correct for actual Temperature and Pressure referenced to Standard Conditions, the observed reading from the manometer is adjusted using the following equation.

H_2O (STP) = H_2O x (P2/Pstd) (Tstd/T2)

H_2O = manometer reading

P2 = from equation above

Pstd = 760 mmHg

Tstd = 298.16 deg K

T2 = from equation above

14. Obtain the flow rate in cubic meters per minute (m^3/min) from the manometer reading in inches of H_2O (inH_2O) using the chart that comes with the kit. Use the bottom trendline.

15. The answers from the equation above now become the x-axis points on the graph.

16. To correct observed rotometer readings for Temperature and Pressure referenced to Standard Conditions, the observed reading from the rotometer must be adjusted using the following equation.

I (STP) = I x (P2/Pstd) (Tstd/T2)

I = observed rotometer reading

P2 = from equation above

Pstd = 760 mmHg

Tstd = 298.16 deg K

T2 = from equation above

17. The answers from the above equation are the y-axis points for the graph.

18. Now, use the x-axis and y-axis points to plot the graph. Draw a line through the dots, keeping the line as straight as possible. **Note:** The line does not have to pass directly through the points, but as close to the points as possible keeping a straight line.

19. Keep the chart with the Staplex for use during sampling. From the flow rate observed (the x-axis), find the corresponding corrected flow rate on the y-axis. This should also be corrected for temperature and pressure if different than that during calibration. Use that number and the sample time to calculate the volume of air sampled.


Stoplex
Stoplex

Breathing Zone Monitor

RIO ALGOM MINING LLC

Air Sample Pump Calibration Form

Date 10/9/2012 ~~10/10/2012~~ 10/11/2012

Calibration Performed By L. Les

Sampling Pump Use	Required Flow rate (Lpm)	Bubble Tube Time (sec)	Acceptable Range @ +4% (sec)
Radon daughter monitoring	2	24	23 - 25
Gravimetric dust sampling	1.7	28	26.9 - 29.1

Successful calibration requires 3 consecutive readings that fall within the acceptable range listed in the table above.

Calibration Results

	Airchek 2200 Sn 9814534 PUMP			
Test Run	Pre 10/9/2012	Post	Pre 10/10/2012	Post
1	1758	1770	1782	1775
2	1763	1769	1785	1774
3	1763	1770	1783	1775
4	✓		✓	
5	AVG = 1.7 l/m		AVG = 1779 (1.7 lpm)	
6				
7				
8				
9				
Result				

10/9/2012 Placed on Jimmie Gonzales at 0820 removed 1656
10/11/2012 Zach Knowles 0837- 1640 (8 hrs 3 min)

Comments

RIO ALGOM MINING LLC

Air Sample Pump Calibration Form

Date 10/13/2012 -10/15/2012

Calibration Performed By Darrell Estes

Sampling Pump Use	Required Flow rate (Lpm)	Bubble Tube Time (sec)	Acceptable Range @ ±4% (sec)
Radon daughter monitoring	2	24	23 - 25
Gravimetric dust sampling	1.7	28	26.9 - 29.1

Successful calibration requires 3 consecutive readings that fall within the acceptable range listed in the table above.

Calibration Results

	PUMP			
Test Run	Pre (Accuhaler S/N 981454 10/13/2012)	Post	Pre (Accuhaler S/N 981454)	Post 10/15/2012
1	1692	1680	~~1730~~ 1746	
2	1699	1685	1745	
3	1701	1685	1748	
4	✓			
5	AVERAGE = 1693			
6	= 17 LPM			
7				
8				
9				
Result				

Comments _____

_____

RIO ALGOM MINING LLC

Air Sample Pump Calibration Form

Date 10/17/2012 - 10/24/2012

Calibration Performed By Liles

Sampling Pump Use	Required Flow rate (Lpm)	Bubble Tube Time (sec)	Acceptable Range @ +4% (sec)
Radon daughter monitoring	2	24	23 - 25
Gravimetric dust sampling	1.7	28	26.9 - 29.1

Successful calibration requires 3 consecutive readings that fall within the acceptable range listed in the table above.

Calibration Results

	PUMP			
Test Run	Airchek s/n 9814534 10/17/2012		s/n 9814534 10/24/2012	
1	1776	1814	* ~~1768~~ 1768	1774
2	1777	1825	* 1772	1770
3	1775	1818	* 1764	1768
4			NC 1768	1770 NC
5		1797 = 1.8 l/min		
6				NC = 1767 = 1.7 l/min
7				
8				
9				
Result				

* not an always reliable shutting off before will always

Comments

RIO ALGOM MINING LLC

Air Sample Pump Calibration Form

Date 10/25/2012

Calibration Performed By L. Iles

Sampling Pump Use	Required Flow rate (Lpm)	Bubble Tube Time (sec)	Acceptable Range @ +4% (sec)
Radon daughter monitoring	2	24	23 - 25
Gravimetric dust sampling	1.7	28	26.9 - 29.1

Successful calibration requires 3 consecutive readings that fall within the acceptable range listed in the table above.

Calibration Results

	981454	PUMP		
Test Run	10/25/12	Josh		
1	1774	1824		
2	1776	1833		
3	1790	1860		
4	—			
5 AVG	1780	1836		
6		V		
7	AVG	1809 = 1.8 l/m		
8				
9				
Result				

Comments _____

A.P. BUCK, INC.
7101 Presidents Drive • Suite 110 • Orlando, FL 32809 USA
Tel 1-800-330-2825 407-851-8602 • Fax 407-851-8910
apbuck@apbuck.com • www.apbuck.com

BUCK
A.P. BUCK INC.

MAN-MINI REV-C
10/07/2005

Manual Part No. APB-108016

BUCK
A.P. BUCK INC.

THE mini-BUCK CALIBRATOR®

Model M-1
Model M-5
Model M-30

INSTRUCTION MANUAL

VERSION: 2

7101 Presidents Drive • Suite 110 • Orlando, FL 32809
Tel: (407) 851-8602 • Fax: (407) 851-8910

apbuck@apbuck.com • www.apbuck.com

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OWNER REGISTRATION

Please complete and fax this card to **407-851-8910** to properly register your unit
OR register on line at www.apbuck.com on the service and support page.

Contact Name _____

Company _____

Address _____

City _____ State _____ Zip Code _____

Country _____ Phone Number _____

Fax _____ Email Address _____

Purchased From _____

Purchase Date _____

Important: List all products purchases and corresponding serial numbers:

_____ _____ _____

_____ _____ _____

Please obtain an RMA number prior to returning any product. Call us at 407-851-8602 and have the serial number and model of the unit available.

OWNER SURVEY

Where did you learn about our products:

☐ Mailing

Direct Sale ☐ Phone/Fax ☐ Website

☐ Magazine _____
Name & Issue Date

☐ Trade Show

☐ Distributor ☐ Referral
Name: _____

What made you decide to buy:

☐ Product Technology / Features

☐ Product Quality / Reliability

☐ Price

☐ Reputation of Company

☐ Product Availability

☐ Service / Support

Comments: _____

_____

Table of Contents

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Section 10

WARRANTY

The seller warrants to the Purchaser that any equipment manufactured by it and bearing its name plate to be free from defects in material or workmanship, under proper and normal use and service, as follows: if, at any time within 1 year from the date of sale, the Purchaser notifies the Seller that in his opinion, the equipment is defective, and returns the equipment to the Seller's originating factory prepaid, and the Seller's inspection finds the equipment to be defective in material or workmanship, the Seller will promptly correct it by either, at its option, repairing any defective part or material or replacing it free of charge and return shipped lowest cost transportation prepaid (if Purchaser requests premium transportation, Purchaser will be billed for transportation costs). If inspection by the Seller does not disclose any defect in material or workmanship, the Seller's regular charges will apply. This warranty shall be effective only if installation and maintenance is in accordance with our instructions and written notice of a defect is given to the Seller within such period. This warranty is exclusive and is in lieu of any other warranties, written, oral or implied; specifically without limitation, there is no warranty of merchantability or fitness for any purpose. The liability of the Seller shall be limited to the repair or the replacement of materials or parts as above set forth.

LIMITATION OF LIABILITY

The seller shall not be liable for any claim for consequential loss or damage arising or alleged to have risen from any delay in delivery malfunction or failure of the equipment. The Seller's liability for any other loss or damage arising out of or connected with the manufacture, sale or use of the equipment sold, including damage due to negligence, shall not in any event exceed the price of the equipment supplied by us.

A.P. Buck, Inc. reserves the right to make changes at any time, without notice, in prices, colors, materials, specifications, and models; and to discontinue models.

Section 1

Analysis of Air Flow Calibration

a. Physics of Measurement

At room temperature, all gases obey – to a very close approximation – the ideal gas equation PV = nRT, where P is the pressure in newtons per square meter, V is the volume in cubic meters, n is the number of moles of gas, R is the empirically determined gas constant with the approximate value 8.31 joules/mole degrees Kelvin and T is the temperature in degrees Kelvin.

The method of measuring flow rates in the mini-Buck Calibrator is the technique known as the soap film bubble test. A frictionless soap film is suspended perpendicular to the air flow up a small bore tube. This film forms a complete seal across the tube. The effect causes the soap film to move along the tube at exactly the same rate as the air flow. Knowing a measured distance and tube bore size, a volume can be calculated. Thus, a flow rate can be determined by the movement of soap film across a fixed volume per unit of time. This technique is classified as a Primary Standard.

By comparing the four variables of the Ideal Gas Law against this detection technique, the validity of measurement can be accessed. The volume (v) is known and fixed therefore cannot change or be considered variable. The mass (m) of the gas being measured is not changed in this technique as the soap film is simply suspended across the tube cross section and moves with the gas flow rate. Mass is not affected. This leaves pressure and temperature. These are expressed by Boyle's Law $P_1V_1 = P_2V_2$ and Charles Law $V_2/V_1 = T_2/T_1$. No pressure changes from the ambient during a test as the soap film is practically frictionless. Temperature has no influence in this type of flow measurement when all elements are at an ambient. This includes the Calibrating device, the flow of gas and room temperature. These conditions are the general circumstances in which tests are performed.

Conclusion: The detection method of measuring flow rates of gases over a fixed volume per given unit of time is for all practical purposes independent of all variables in the Ideal Gas Law. Thus, the mini-Buck Calibrator® serves as a primary standard calibration method.

Lippman, Morton, "The Industrial Environment – its Evaluation and Control," [U.S. Department of Health, Education and Welfare], NIOSH, 1973, Ch 11, 101 pp

b. Accuracy of Gaseous Flow Measurements

To properly evaluate the accuracy of flowing gases, two parameters must be considered. First, the steadiness of the flow rate must be known. Practically every type of pump creates some pulsing of the flowing gases. Second, the rate of flow can drift up and down over some range. Current battery powered personal air sampling pumps use various techniques to dampen pulsing and special circuitry to monitor pump speed, thereby, attempting to generate constant and steady flows.

The mini-Buck Calibrator® is an automation of the "classic" technique of using a soap film seal to measure flow over a predetermined volume in a known time. A microprocessor, operating at 6 megahertz per second, detects the passing of the soap film seal over the established flow tube volume and automatically calculates the rate of flow. The typical apparatus, 1,000 ml buret using a stopwatch, can be significantly reduced in size since the microprocessor can detect and measure the speed at 80 microsecond intervals. Compare this speed to a technician's response time. With good precision on a stopwatch, he or she could be repeatable within 50,000 microsend (0.05) seconds, 625 times slower than the microprocessor.

Consider this analysis: 1,000 cc buret NIST traceable; 0.01 second stopwatch crystal controlled with clock accurate to $\pm$ 15 sec per month; 1,000 cc/min. steady flow source (constant flow $\pm$ 1 cc/min.).

Example: Measure the flow rate using 1,000 cc buret by a skilled technician. All devices are at a constant room temperature.

Test	Time	Actual Flow Rate
1	60.06 sec	999.0 cc/min
2	60.00	1000
3	59.94	1001

Note: At 1,000 cc/min of flow $\pm$ 0.06 is equal to 1 cc/min change or $\pm$ 0.1 accuracy. Repeatability is strictly a function of the technicians' skill.

Mathematically, it would seem 0.1% accuracy could be obtained using this large volume and a skilled technician with a 1,000 cc/min. steady source. Of course, if the volume is smaller than 1,000 cc or the flow is faster, the percent of the accuracy is further reduced by this manual method.

To summarize, the accuracy of measuring air flow relies on quality measurement tools such as NIST traceable buret and crystal control stop-watch. A constant air flow source and a reliable method of detection are the final requirements to achieve repeatable and accurate flow readings.

Section 9

mini-BUCK Parts List

1.	A/C Adapter Charger	
	120V	APB-108010
	230V	APB-108012
2.	Soap (8 oz. Bottle of soap)	APB-107030
3.	Soap dispenser bottle	APB-107032
4.	Instruction Manual	APB-108016
5.	Air inlet caps (Pkg. of two)	APB-107014
6.	A Cell Battery Pack, 4 in line	APB-108015
7.	Carrying Case	APB-108000

Note: MINIMUM ORDER: $25.OO FOB Orlando, Florida

SERVICE POLICY for Out of Warranty Work:

The company reserves the right to proceed with repairs for parts and labor up to a maximum cost of $295.00 without notifying the customer. If major components must be replaced, the customer will be notified before repairs are performed and actual costs provided for his or her approval of needed work.

When a Calibrator is returned, please include a purchase order marked "Repair Cost not to Exceed $295.00 Without Customer Authorization". Also include company name, return shipping address, contact name and phone number, serial number of unit, date of purchase and description of any problems. Return to:

A. P. Buck, Inc.
7101 Presidents Drive
Suite 110
Orlando, FL 32809
ATTN: RMA#

Section 7

Power Supply

1. The battery supply utilizes 4 NiCad AA Cell batteries. The unit will operate up to 100 hours on a fully charged battery. The unit may also be operated directly from the AC charger when batteries are low.
2. Low battery light will indicate the power supply is too low for accurate results.
3. Charge battery pack for 16 hours minimum using the BUCK standard charger.
4. A special power saving feature is the Automatic Shut Off. After 7 minutes of non-use, the mini-Buck will shut off automatically.

Section 8

Precautions/Warnings

1. Avoid the use of chemical solvents on flow cell, calibrator case and faceplate. Generally, soap and water will remove any dirt.
2. Never pressurize the flow cell at any time with more than 25 inches of water pressure.
3. Do not leave A/C adapter plugged into calibrator when not in use as this could damage the battery supply.
4. Hose fitting covers help to reduce evaporation of soap in the flow cell when not in use.
5. The mini-BUCK Calibrator Soap is a precisely concentrated and sterilized solution formulated to provide a clean, frictionless soap film bubble over the wide, dynamic range of the calibrator. The sterile nature of the soap is important in the prevention of residue build-up in the flow cell center tube, which could cause inaccurate readings. The use of any other soap is not recommended.

Section 2

Principle of Operation and Features

a. Design and Basic Features

The mini-Buck Calibrator® utilizes the principle of measuring the flow rate of gases over a fixed volume per unit of time. A Quartz controlled timer is the timing device and the fixed volume is located in the flow cell center tube. A microprocessor measures the time for a frictionless soap film to travel from the first sensor to the second sensor (infrared which detects the passage up to the tube) and then calculates the volume per unit of time. The results are displayed in flow rate, cc/min. for the models M-1 and M-5, Liters Per Minute for model M-30 on a four digital liquid crystal display. The decimal point floats to present the data in the proper range. The timer is capable of detecting a soap film less than 80 microsecond intervals. This speed allows under steady flow conditions an accuracy of +/- 0.5% of any display. The unique flow cell can create a soap film over a range of:

M-1 0.1 to 300 cc/m
M-5 1 to 6000 cc/m
M-30 0.100 to 30.00 LPM

The flow cell is spill proof when properly filled.

b. Understanding the Display Results

A unique feature of the microcomputer software program is data display. On initiation, the mini-Buck display will present 8888's for 3 seconds and then display 0000's with no decimal point indicated. A series of ---- are displayed while a test is in progress. During sequential tests, the previous reading is added to the current test as a running total. The letter A– appears after each test display the number in the averaging. If the previous reading and current reading are different by more than $\pm$ 5% a series of EEEE's will flash four times on the display and then display the actual last rest result. The next flow readings will start this averaging technique over again. If individual readings are desired without averaging, the "ON" button may be pushed to reset the unit to "0000" following each test. The flashing numbers on the display after a test are for three seconds duration. The purpose is to allow sufficient time for the soap to return to the bottom reservoir.

c. Battery saver

Another feature of the mini-Buck is the battery saver "automatic shut down". If a test is not conducted within approximately 7 minutes from turn on, the Calibrator will turn itself off. Continuous use of the batteries is rated at 100 hours. The unit may also be operated directly from the A/C charger when batteries are low. All units should be given an initial 16 hour charge prior to use. A low battery light will indicate when it is time to recharge the battery. If stored for a period of 30 days or more, unit will require a 16 hour charge

IMPORTANT INFORMATION

Your mini-BUCK Calibrator has new enhanced operational features.

Effective October 1, 2005 Version 2

FEATURES

- Pressing the ON and OFF keys simultaneously will display the Version of software code.

- An audible beep will be made upon pressing of keys pads and with the start and stop of bubble test. This beeping feature may be turned off by holding the ON key for five seconds.

- Each flow measurement is a true running average with the current test being added to the previous test and divided by the number of tests performed at that time. Average test number is displayed after each bubble test as A-1, A-2 etc. Pressing the ON key resets the averaging to start over and displays the current test.

- Upon turn-on, the display is "8888" briefly, as a system check, and then becomes "0000".

- The circuit board has advanced technology for improved accuracy and to maintain calibration with longer battery life. Up to 100 hours of usage on an over night charge.

Original features of "EEEE" being displayed, if the reading has changed by 5 % from previous reading or is out of the flow range remains in Version 2.

Section 5

Calibrator Maintenance

General Information:

To clean the flow cell, simply remove the three screws holding the flow cell to the bottom of the case. Remove the flow cell and gently flush with tap water. To prevent scratching the acrylic flow cell, wipe "only" with a soft cloth. Do not allow center tube, where sensors detect soap film to be scratched or get dirty. NEVER clean with ACETONE. Use only soap and warm water. When cleaning prior to storage, allow flow cell to air dry. Shake any access water from cell prior to reattaching to base of mini-BUCK.

If stubborn residue persists, remove the bottom plate. Squirt a few drops of soap into slot between base and flow cell to ease removal. Gently insert a coin or flat screw driver into the ridge between the bottom plate and chamber using leverage around the circumference of the cell until the bottom plate is removed. Upon realigning, note scribe mark near one of the screw inserts on bottom plate and align this mark with scribe mark on flow cell near air hose inlet. Again, wet O-ring with soap prior to installation.

To reassemble, realign flow cell in case with hose nipples pointing to back of case and reinstall the three bottom screws.

Section 6

Calibrator Verification

The calibrator is factory calibrated using a standard traceable to National Institute of Science and Technology (N.I.S.T.) Attempts to verify calibrator against a glass one liter buret should be conducted at 1000 cc/min. for maximum accuracy. The calibrator is linear throughout the entire range due to the detection technique of "fixed volume per unit of time". See Section 1 for principle of operation

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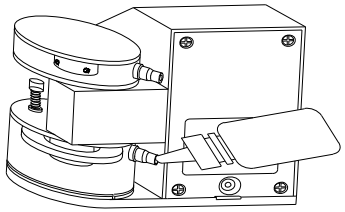
Section 3

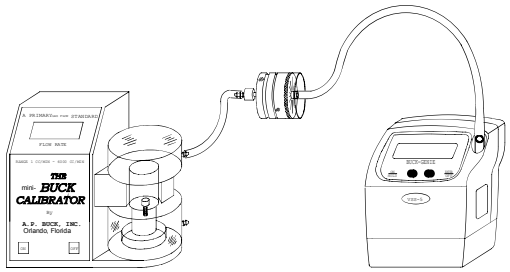
Start Up Procedure

Read the previous section of Principle of Operation if unfamiliar with device.

Soap volume is not critical, therefore a measured amount is not necessary. The proper amount is that which is sufficient to create a bubble. Simply pour a small amount of soap through the bottom nipple to thoroughly cover the bottom of the flow cell and attach air source to nipple (bottom nipple for pressure, top nipple for vacuum). Excessive amount of soap may cause a continuous stream of bubbles to go up the center tube at high flows. **NOTE: Tip the Min-BUCK with the bottom hose pointed to the floor for excess soap to be expelled. Only the proper amount will remain.**



C. Wet flow cell by connecting a pump flowing at 1000 to 2000 cc/min. for Model M-5 and 5 LPM for Model M-30. Initiate soap film up center tube by rapidly pressing button down and releasing. Repeat this procedure until bubble doesn't break. The tube is now wet and tests at any range may be conducted. One minute warm up time is all that is required of the mini-Buck.



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Section 4

Calibration of Air Flow Sources with The mini-Buck

These instructions apply to all models. The range for each are:

Model M-1 = 0.1 to 300 cc/min
Model M-5 = 1.000 to 6000 cc/min.
Model M-30 = .001 to 30.00 Liter per Minute

The instructions relate to industrial hygiene air sampling. It basically applies to any gases flow rate measurements.

1. Start the pump and allow approximately 5 minutes to stabilize. Perform this step before connecting to flow cell as air flow dries center tube if bubbles are not initiated at intervals.
2. Connect sampling medium to pump by obtaining proper hose adapters for connecting tubing to flow cell. The flow cell hose connectors will accept two common sizes of vinyl tubing (1/4" and 51/6"). A "Luer" fitting is incorporated in the upper hose connector. The upper port is for vacuum and the bottom for pressure. When the upper port is connected to vacuum, the lower port must be open to the atmosphere. Conversely, when the lower port is connected to pressure, the upper port must be open to free air. Never make bubble test with bottom hose connected in series (in line with sampling filter).
3. Wet the flow cell as described in Section 3.
4. Begin Calibration: depress plunger into cell and quickly release. Different flow rate can require quicker or slower release of the button.
5. Carefully observe the bubble passing through the sensor zone. Only a single straight bubble, perpendicular to the tube wall, is necessary for an accurate test. If several bubbles go up to the tube at once it will not effect the test data because the first sensor will not reset until the final sensor has been tripped. A good technique is to watch the bubble pass up the tube to ensure a good test has been conducted.
6. Observe the display. A number will be displayed. The decimal point will be appropriately placed. Read section 3-b on features concerning data display.
7. After a 3 second delay from the time the final sensor is tripped, another test can be performed.
8. Repeat Steps 5 through 8 for minimum of 3 tests.

Note: If difficulty is encountered in making a clean single soap film rise up the center tube:

a. check level of soap in flow cell (Section 3-C).
b. If soap is cloudy (not clear), change the soap solution and clean flow cell.

Verification and Validation for Soil Samples

Verification and Validation Worksheet

ALS Work Order: 1211066 Number of soil samples: 19 (the 19 consist of unique 16 field samples and 3 field duplicates; additionally there are 2 laboratory duplicates, 1 method blank and 1 laboratory control spike)
Sample ID(s): RWU2(005, 007, 008, 009, 009, 010, 010, 011, 012, 012, 013, 101, 102); RWU3(001, 003, 006, 008, 011, 102)
Sample Date(s): 25 Oct 2012, 30 Oct 2012, 31 Oct 2012, 01 Nov 2012, 02 Nov 2012
Analyte(s): Ra-226 (pCi/g) 19

Sample Preparation Method(s): N/A
Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra)
Sample Analytical Method(s): EPA901.1 (Ra)
Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra)

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?		X[1]	
Was shipping and receiving performed without issue?	X		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]			X
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[A]			X
Was the requested MDC met for all field sample results?	X[2]		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?	X		
Were the proper number of QC samples performed by the lab?	X[3]		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X[3]		
Are sample results reasonable when compared to known or expected levels?	X[4]		

A) Not applicable to Ra-226 by Method 901.1

Notes:

1. Lab ID 1211066-19 had COC ID of RWU2-011 and bottle ID of RWU2-101. This was identified and corrected prior to laboratory analysis (correct on lab report). The correct ID is RWU2-101. This does not affect the quality of the results.
2. The requested MDC of 1 pCi/g was not met for the Lab Control Spike (LCS Lab ID GS121107-3) which has been flagged with M3, "The requested MDC was not met, but the reported activity is greater than the reported MDC." The requested MDC was met for all other samples in this work order.
3. Some of the Ra-226 samples were flagged with a G, "Sample density differs by more than 15% of LCS density." These results may be biased high.
4. Ra-226 results ranged from 0.86-2.01 pCi/g.
5. Field Duplicates: RWU2-101 is a duplicate for RWU2-005; RWU2-102 is a duplicate for RWU2-008; RWU3-102 is a duplicate for RWU3-008

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 08 January 2012

Verification and Validation Worksheet

ALS Work Order: 1211078 Number of soil samples: 13 (13 field samples consisting of 12 unique field samples and 1 field duplicate, 2 lab duplicates, 1 method blank and 1 laboratory control spike)
Sample ID(s): RWU2(001, 002, 003, 004, 014); RWU3(002, 004, 005, 007, 013, 014, 015, 101)
Sample Date(s): 01 Nov 2012, 02 Nov 2012
Analyte(s): Ra-226 (pCi/g) 13

Sample Preparation Method(s): N/A
Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra)
Sample Analytical Method(s): EPA901.1 (Ra)
Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra)

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?		X[1]	
Was shipping and receiving performed without issue?	X		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]			X
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[A]			X
Was the requested MDC met for all field sample results?	X[2]		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?	X		
Were the proper number of QC samples performed by the lab?	X[3]		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X[3]		
Are sample results reasonable when compared to known or expected levels?	X[4]		

A) Not applicable to Ra-226 by Method 901.1

Notes:

1. Lab ID 1211078-6 had COC ID of RWU3-003 and bag ID of RWU2-003. (RWU2-003 is correct).
   Lab ID 1211078-13 had COC ID of RWU3-011 and bag ID of RWU3-101 (RWU3-101 is correct)
   These errors were identified and corrected prior to laboratory analysis (correct on lab report). This does not affect the quality of the results.
2. The requested MDC of 1 pCi/g was not met for the Lab Control Spike (LCS Lab ID GS121107-4) which has been flagged with M3, "The requested MDC was not met, but the reported activity is greater than the reported MDC." The requested MDC was met for all other samples in this work order.
3. Some of the Ra-226 samples were flagged with a G, "Sample density differs by more than 15% of LCS density." These results may be biased high.
4. Ra-226 results ranged from 0.88-2.35 pCi/g.
5. Field Duplicates: RWU3-101 is a duplicate for RWU3-005.

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 08 January 2012

Verification and Validation Worksheet

ALS Work Order: 1210098 Number of soil samples: 3
Sample ID(s): 001-GSG-1inch, 002-GSG-RB, 003-GSG-RB
Sample Date(s): October 5, 2012
Analyte(s): Ra-226 (pCi/g) 3,
Sample Preparation Method(s): NA
Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra)
Sample Analytical Method(s): EPA901.1 (Ra),
Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra),

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?	X		
Was shipping and receiving performed without issue?	X		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]	X		
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[B]	X		
Was the requested MDC met for all field sample results?	X		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?	X		
Were the proper number of QC samples performed by the lab?	X		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X		
Are sample results reasonable when compared to known or expected levels?	X[1]		

A) Applicable to K and Th only. B) Not applicable to Ra-226.

Notes:

1. The sample results increase along with increasing sample number which is very unusual.

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 24 January 2013

Verification and Validation Worksheet

ALS Work Order: 1209350 Number of soil samples: 10

Sample ID(s): 1-ERM, 2-ERM, 3-ERM, 4-ERM, 5-ERM, 1-GSG, 2-GSG, 3-GSG, 4-GSG, 5-GSG and one lab duplicate for Ra-226

Sample Date(s): September 18, 2012

Analyte(s): Ra-226 (pCi/g) 10, Total Uranium (U) (µg/kg) 10 , Total Thorium (Th) (µg/kg) 10.

Sample Preparation Method(s): SW3050B (U & Th)

Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra), SOP806 (K & Th)

Sample Analytical Method(s): EPA901.1 (Ra), SW6020A (U & Th)

Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra), SOP827 (U & Th)

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?	X		
Was shipping and receiving performed without issue?	X[1]		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]	X		
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[B]	X		
Was the requested MDC met for all field sample results?	X		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?	X		
Were the proper number of QC samples performed by the lab?	X		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X		
Are sample results reasonable when compared to known or expected levels?	X		

A) Applicable to K and Th only. B) Not applicable to Ra-226.

Notes:

1. Chain of custody seal was ripped off.

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 25 January 2013

Verification and Validation Worksheet

ALS Work Order: 1209099 Number of soil samples: 10

Sample ID(s): SO-350180-203-090612-SC-East Pit (001, 002, 003, 004, 005, 006, 007, 008, 009, 010) and two lab duplicates for Ra-226

Sample Date(s): September 6, 2012

Analyte(s): Ra-226 (pCi/g) 10, Total Uranium (U) (µg/kg) 10 , Total Thorium (Th) (µg/kg) 10.

Sample Preparation Method(s): SW3050B (U & Th)

Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra), SOP806 (K & Th)

Sample Analytical Method(s): EPA901.1 (Ra), SW6020A (U & Th)

Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra), SOP827 (U & Th)

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?	X		
Was shipping and receiving performed without issue?	X[1]		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]	X		
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[B]	X		
Was the requested MDC met for all field sample results?	X		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?	X		
Were the proper number of QC samples performed by the lab?	X		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X		
Are sample results reasonable when compared to known or expected levels?	X		

A) Applicable to K and Th only. B) Not applicable to Ra-226.

Notes:

1. One sample was broken open on receipt and some of the contents were spilled; however; there was sufficient remaining sample for analysis..

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 24 January 2013

Verification and Validation Worksheet

ALS Work Order: 1209098 Number of soil samples: 5
Sample ID(s): SO-350180-203-090612-SC-VHCC (001, 002, 003, 004, 005)
Sample Date(s): September 6, 2012
Analyte(s): Ra-226 (pCi/g) 5, Total Uranium (U) (µg/kg) 5 , Total Thorium (Th) (µg/kg) 5.

Sample Preparation Method(s): SW3050B (U & Th)
Laboratory Prep SOP(s) & Revision(s): SOP739R10 (Ra), SOP806 (K & Th)
Sample Analytical Method(s): EPA901.1 (Ra), SW6020A (U & Th)
Laboratory Analytical SOP(s) & Revision(s): SOP713R12 (Ra), SOP827 (U & Th)

Question	Yes	No	N/A
Was the chain of custody filled out accurately and completely?	X		
Was shipping and receiving performed without issue?	X		
Was the analysis performed that which was requested?	X		
Was the correct preparation and analytical method used for each analyte?	X		
Were samples prepared and analyzed within established holding times?	X		
Were the analytes presented in the correct units?	X		
Are reporting/detection limits acceptable?	X		
Was the method blank within tolerance?	X		
Was the lab control sample within acceptance limits?	X		
Were initial and continuing calibration verifications within acceptance criteria?[A]	X		
Were the MS (accuracy)/MSD (precision) acceptance criteria met?[B]	X		
Was the requested MDC met for all field sample results?	X		
If a sample DUP was performed, was the DER or RPD within acceptance criteria?			X
Were the proper number of QC samples performed by the lab?	X		
Was the surrogate recovery within acceptance criteria?			X
Was the report verified and signed by the laboratory?	X		
If the offsite laboratory case narratives are used to accept nonconforming results, are the provided data qualifiers, QC variances and supporting information technically valid and scientifically defensible?	X		
Are sample results reasonable when compared to known or expected levels?	X[1]		

A) Applicable to K and Th only. B) Not applicable to Ra-226.

Notes:

1. The sample results increase along with increasing sample number which is very unusual.

All of the issues found within this work order are minor and do not affect the overall quality of the data. The data found within this work order are found to be appropriate for use in the characterization of the site as defined by project documentation.

Signed: *Darrell Liles* Dated: 24 January 2013

APPENDIX C

Construction Drawings

Drawing Legend

Drawing Number	Sheet Title
UAO 1	RED Water Pond Road UAO
EC 1	Existing Conditions Station 0+00 to 24+80
EC2	Existing Conditions Station 0+00 to 6+50
EC3	Existing Conditions Station 6+50 to 13+00
EC4	Existing Conditions Station 13+00 to 19+50
EC5	Existing Conditions Station 17+00 to 24+80
EX 1	Excavation Conditions Station 0+00 to 24+80
EX2	Excavation Conditions Station 0+00 to 6+50
EX3	Excavation Conditions Station 6+00 to 13+00
EX4	Excavation Conditions Station 13+00 to 19+50
EX5	Excavation Conditions Station 17+00 to 24+80
AB 1	As Built Station 0+00 to 24+80
AB2	As Built Station 0+00 to 6+50
AB3	As Built Station 6+50 to 13+00
AB4	As Built Station 13+00 to 19+50
AB5	As Built Station 17+00 to 24+80
CAP 1	CR1 Disposal Area- Cap Sub grade
CAP 2	CR1 Disposal Area- Cap Finish Grade
SW1	Seeding and Storm Water Controls
RO 1	Runoff Tracking As Built Station 0+00 to 24+80
RO 2	Runoff Tracking As Built Surface Station 0+00 to 8+50
RO3	Runoff Tracking As Built Surface Station 8+50 to 16+00
RO4	Runoff Tracking As Built Surface Station 15+00 to 24+80
DET 1	Disposal Area Cap and Road Cross Sections
PC 1	Post Construction Photos Station 0+00 to 24+80
PC2	Post Construction Photos Station 0+00 to 6+50
PC3	Post Construction Photos Station 6+50 to 13+00
PC4	Post Construction Photos Station 13+00 to 19+50
PC5	Post Construction Photos Station 17+00 to 24+80
PIT 1	Site and Borrow Pit Locations

Red Water Pond Road Removal Action

Index

Drawing Number	Sheet Title
UAO 1	RED Water Pond Road UAO
EC 1	Existing Conditions Station 0+00 to 24+80
EC 2	Existing Conditions Station 0+00 to 6+50
EC 3	Existing Conditions Station 6+50 to 13+00
EC 4	Existing Conditions Station 13+00 to 19+50
EC 5	Existing Conditions Station 17+00 to 24+80
EX 1	Excavation Conditions Station 0+00 to 24+80
EX 2	Excavation Conditions Station 0+00 to 6+50
EX 3	Excavation Conditions Station 6+00 to 13+00
EX 4	Excavation Conditions Station 13+00 to 19+50
EX 5	Excavation Conditions Station 17+00 to 24+80
AB 1	As Built Station 0+00 to 24+80
AB 2	As Built Station 0+00 to 6+50
AB 3	As Built Station 6+50 to 13+00
AB 4	As Built Station 13+00 to 19+50
AB 5	As Built Station 17+00 to 24+80
CAP 1	CR 1 Disposal Area- Cap Sub grade
CAP 2	CR 1 Disposal Area- Cap Finish Grade
SW 1	Seeding and Storm Water Controls
RO 1	Runoff Tracking As Built Station 0+00 to 24+80
RO 2	Runoff Tracking As Built Surface Station 0+00 to 8+50
RO 3	Runoff Tracking As Built Surface Station 8+50 to 16+00
RO 4	Runoff Tracking As Built Surface Station 15+00 to 24+80
DET 1	Disposal Area Cap and Road Cross Sections
PC 1	Post Construction Photos Station 0+00 to 24+80
PC 2	Post Construction Photos Station 0+00 to 6+50
PC 3	Post Construction Photos Station 6+50 to 13+00
PC 4	Post Construction Photos Station 13+00 to 19+50
PC 5	Post Construction Photos Station 17+00 to 24+80
PIT 1	Site and Barrow Pit Locations

CRA Services

General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy
- Image Taken From Google Earth 12/19/2012

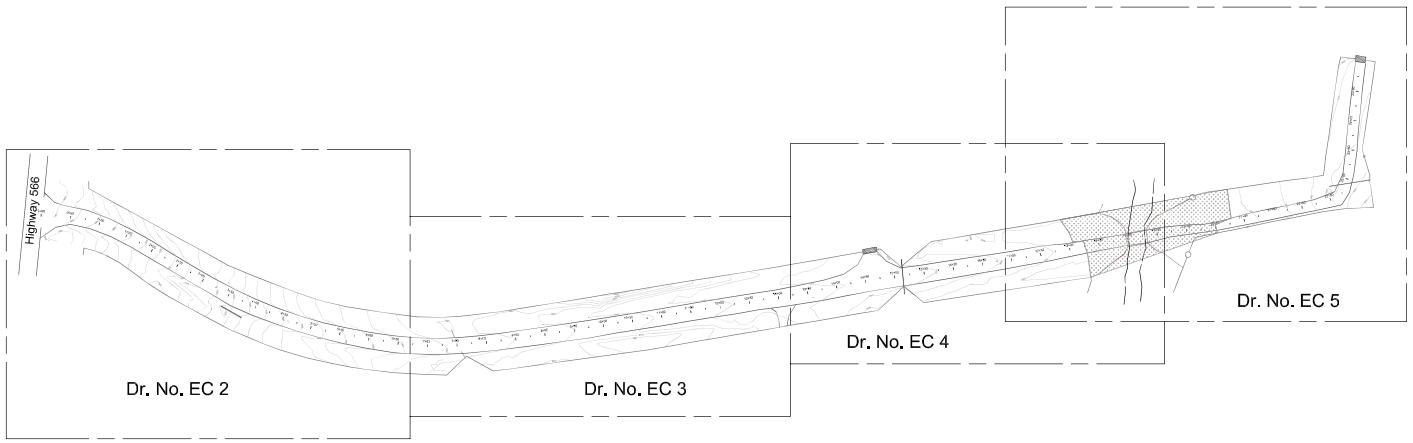
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Red Water Pond Road UAO

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: UAO 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy

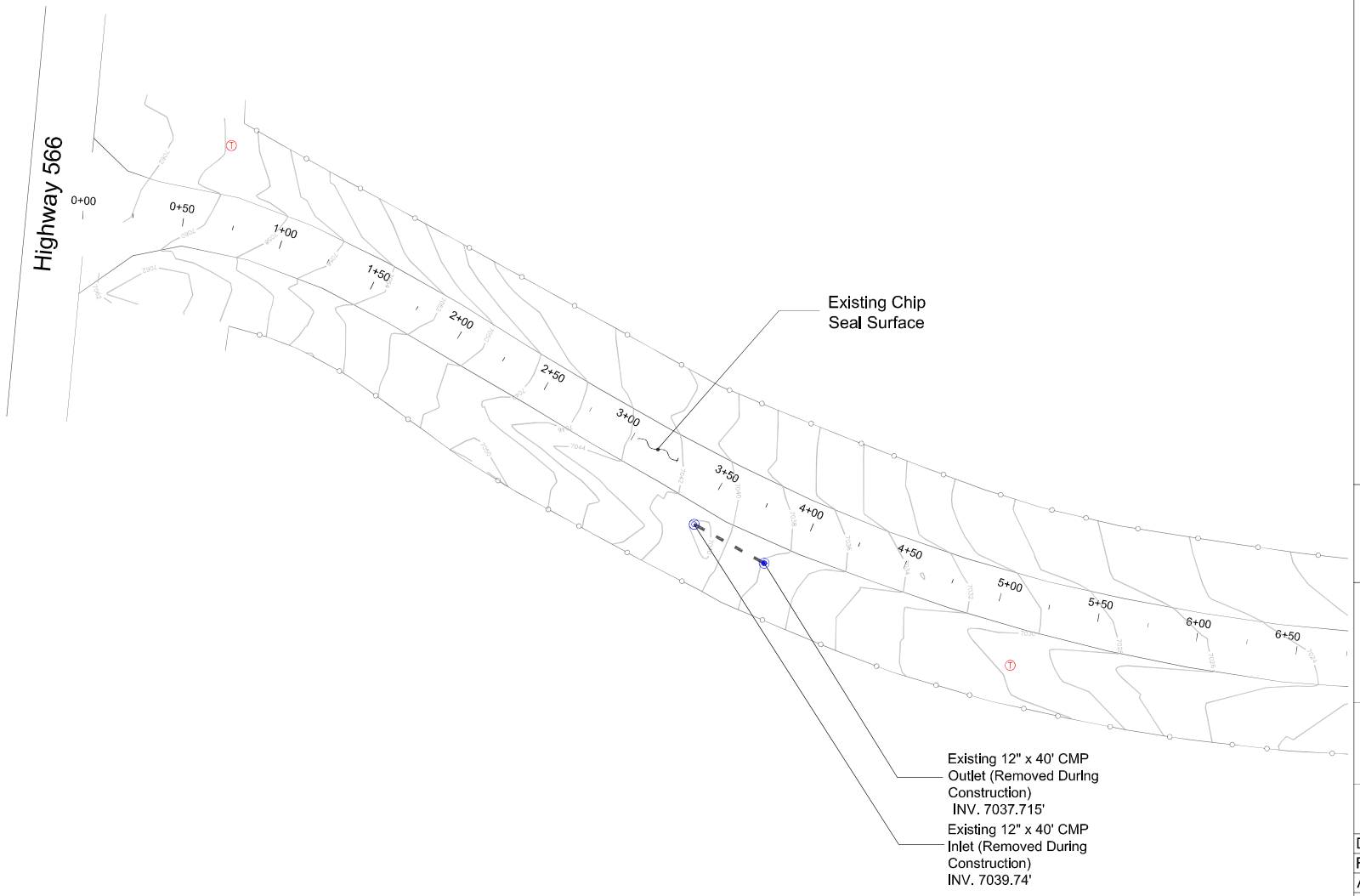
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Existing Conditions Station 0+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EC 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
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0 25 50 75

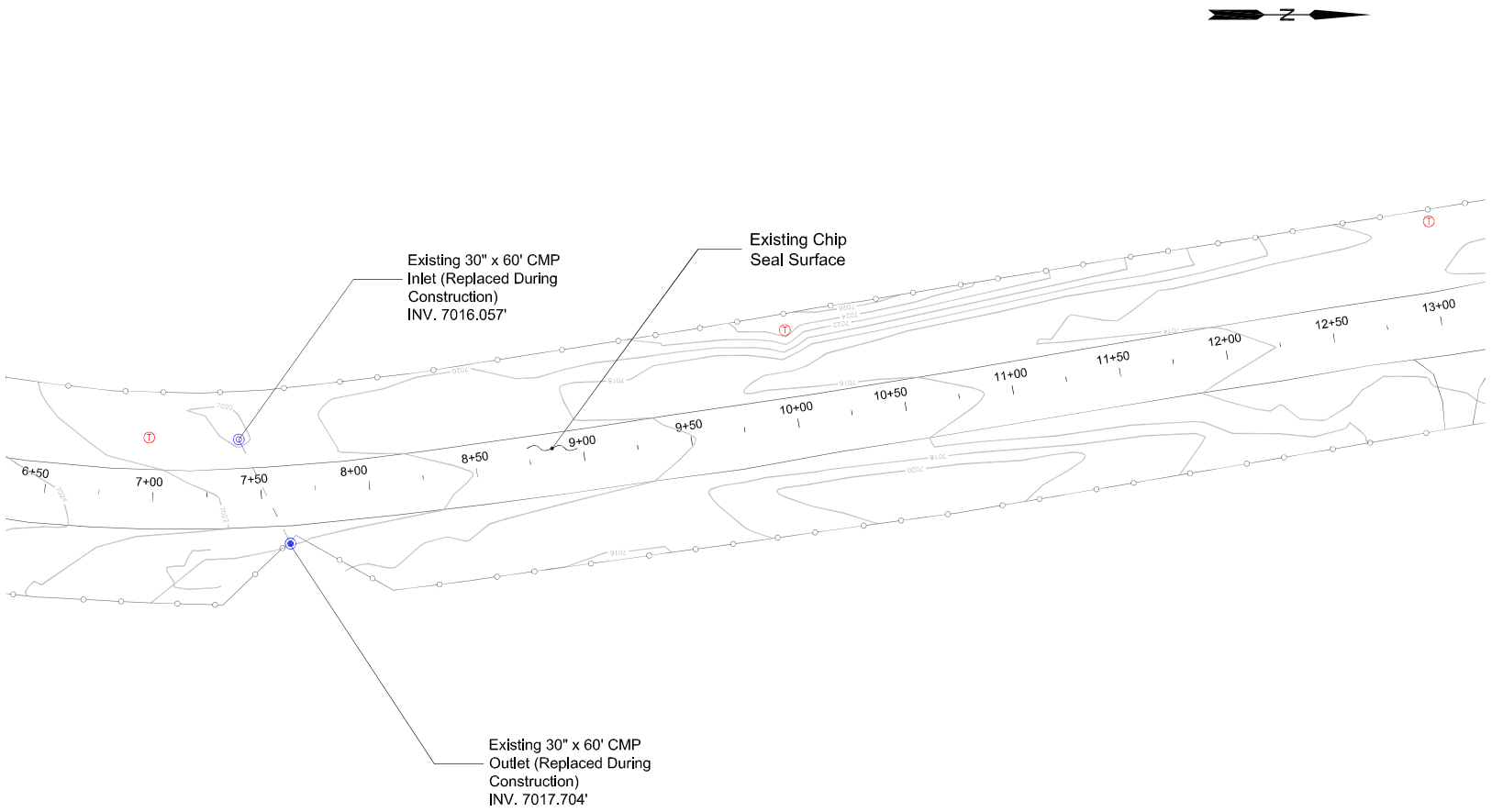
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Existing Conditions Station 0+00 to 6+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EC 2	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
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- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
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0 25 50 75

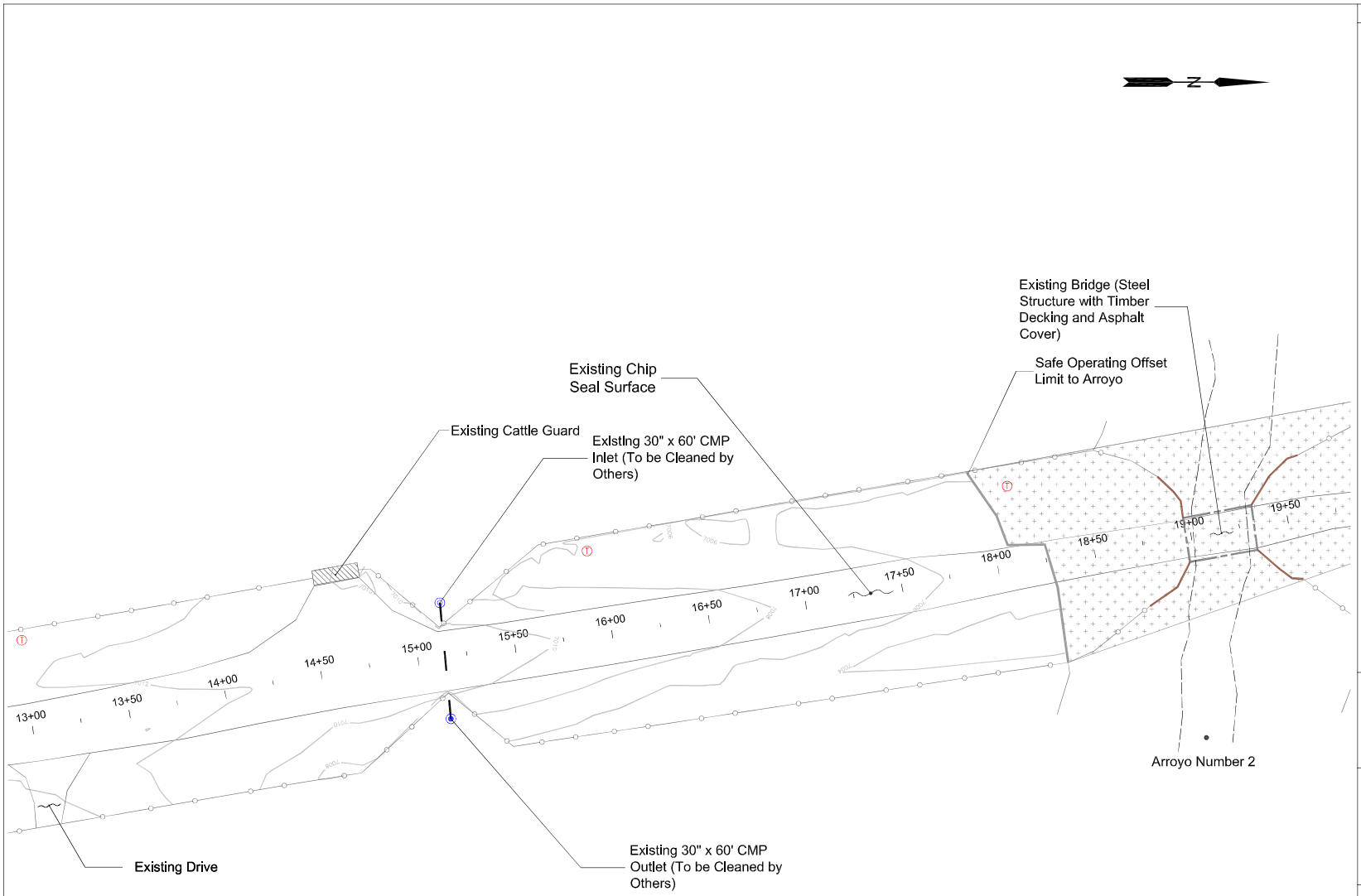
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Existing Conditions Station 6+50 to 13+00

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EC 3	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
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0 25 50 75

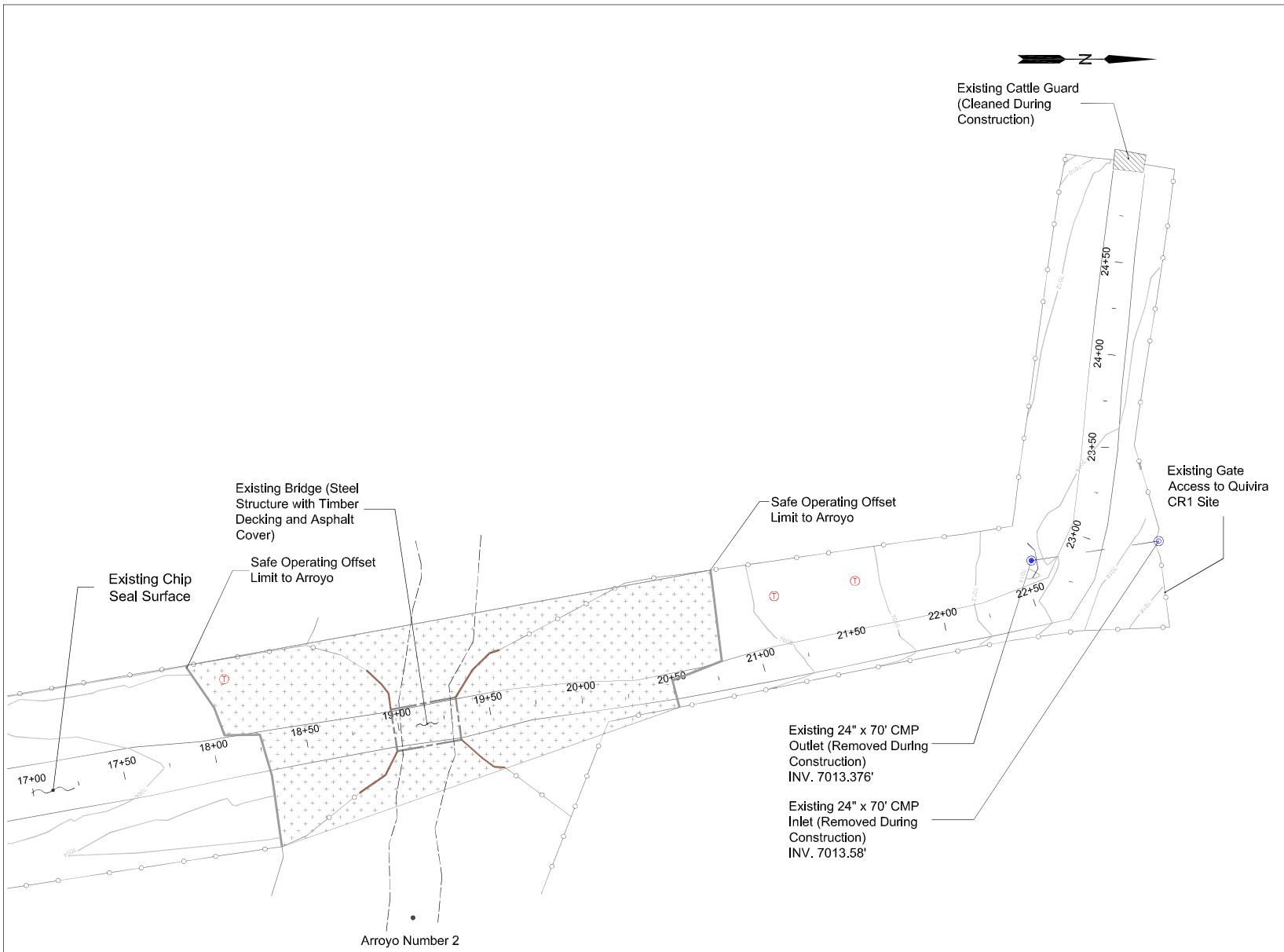
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Existing Conditions Station 13+00 to 19+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EC 4	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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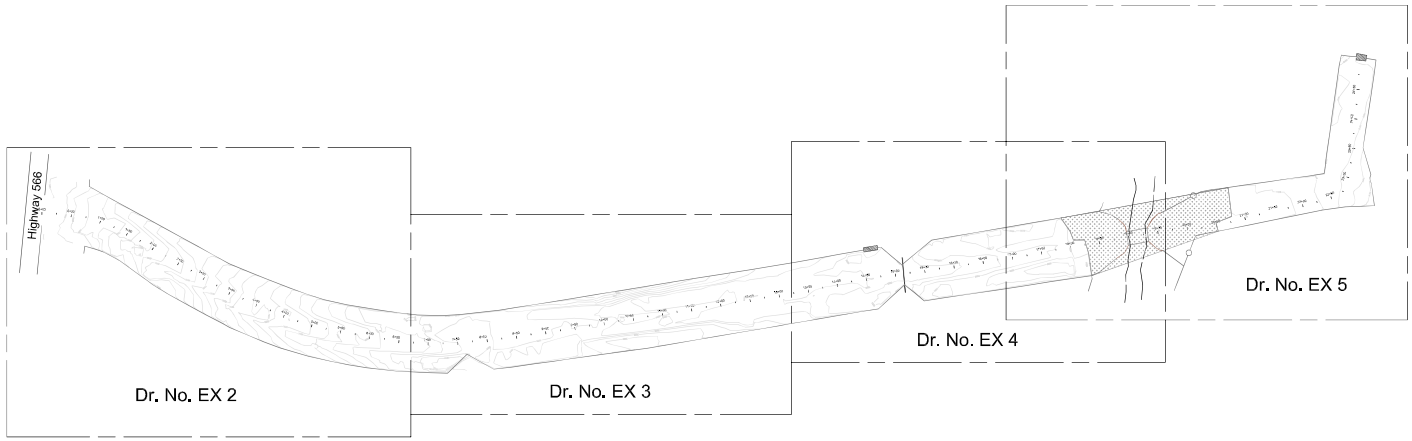
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Existing Conditions Station 17+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EC 5	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
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- Fence
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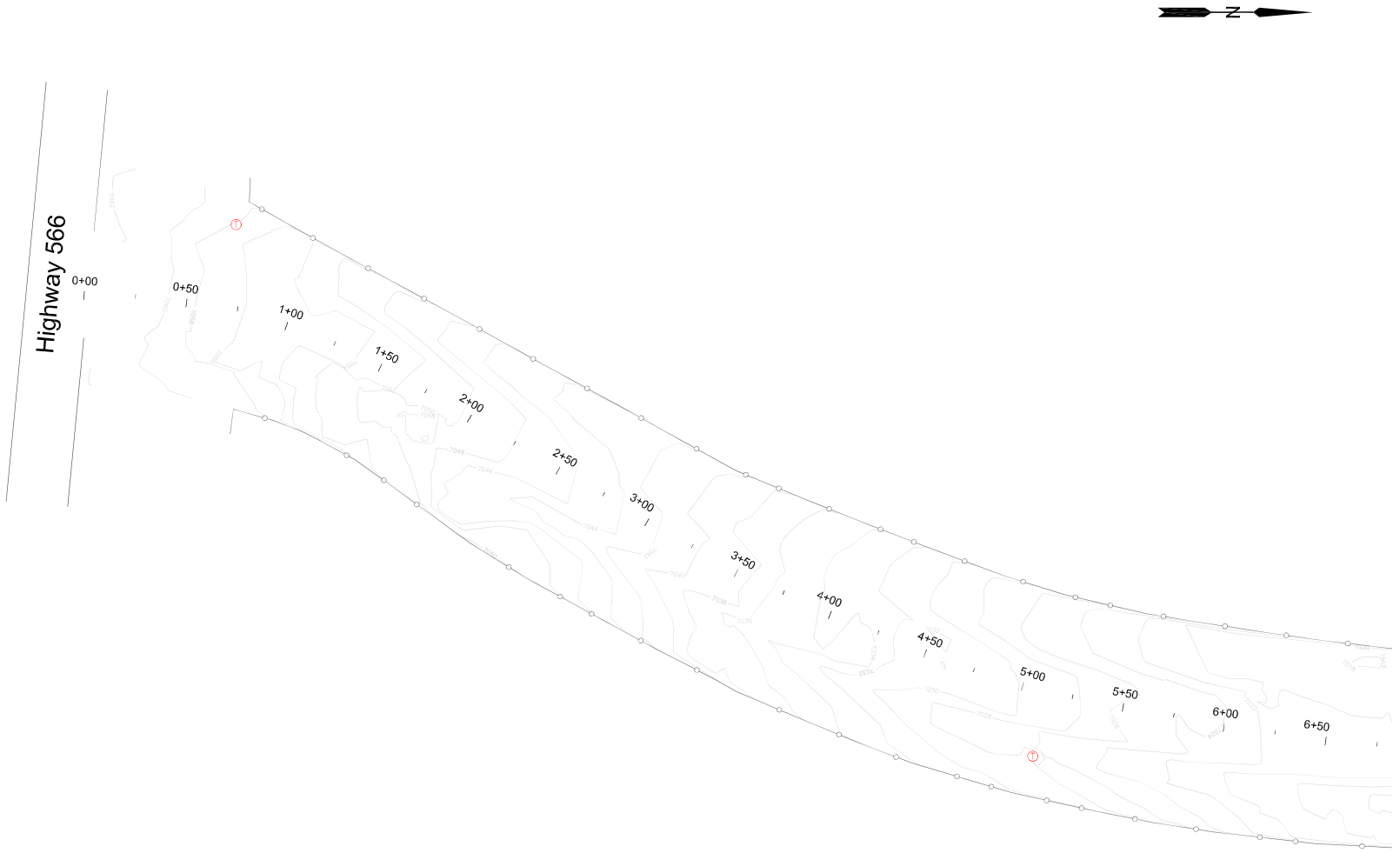
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Excavation Conditions Station 0+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EX 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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0 25 50 75

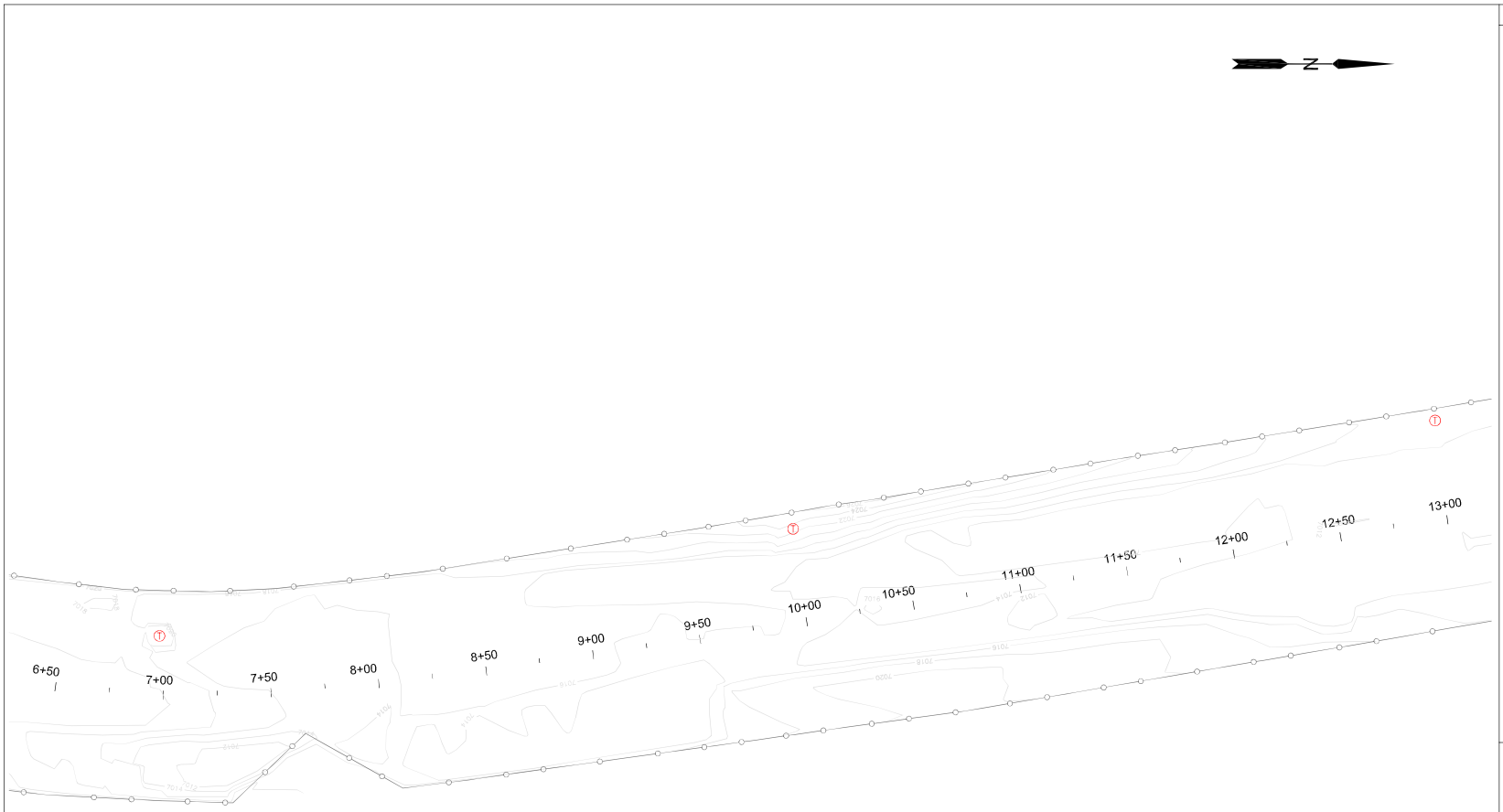
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Excavation Conditions Station 0+00 to 6+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EX 2	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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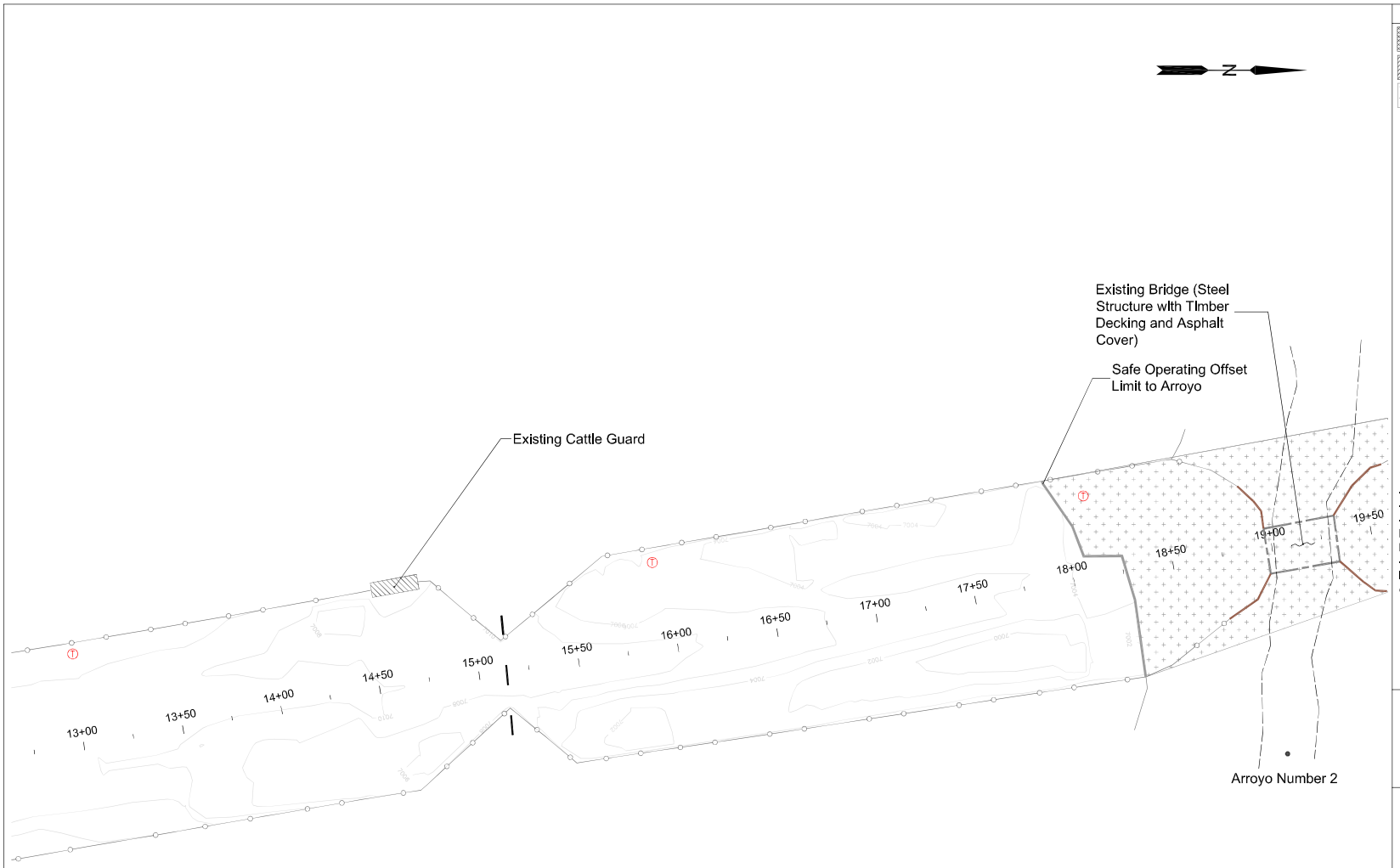
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Excavation Conditions Station 6+00 to 13+00

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EX 3	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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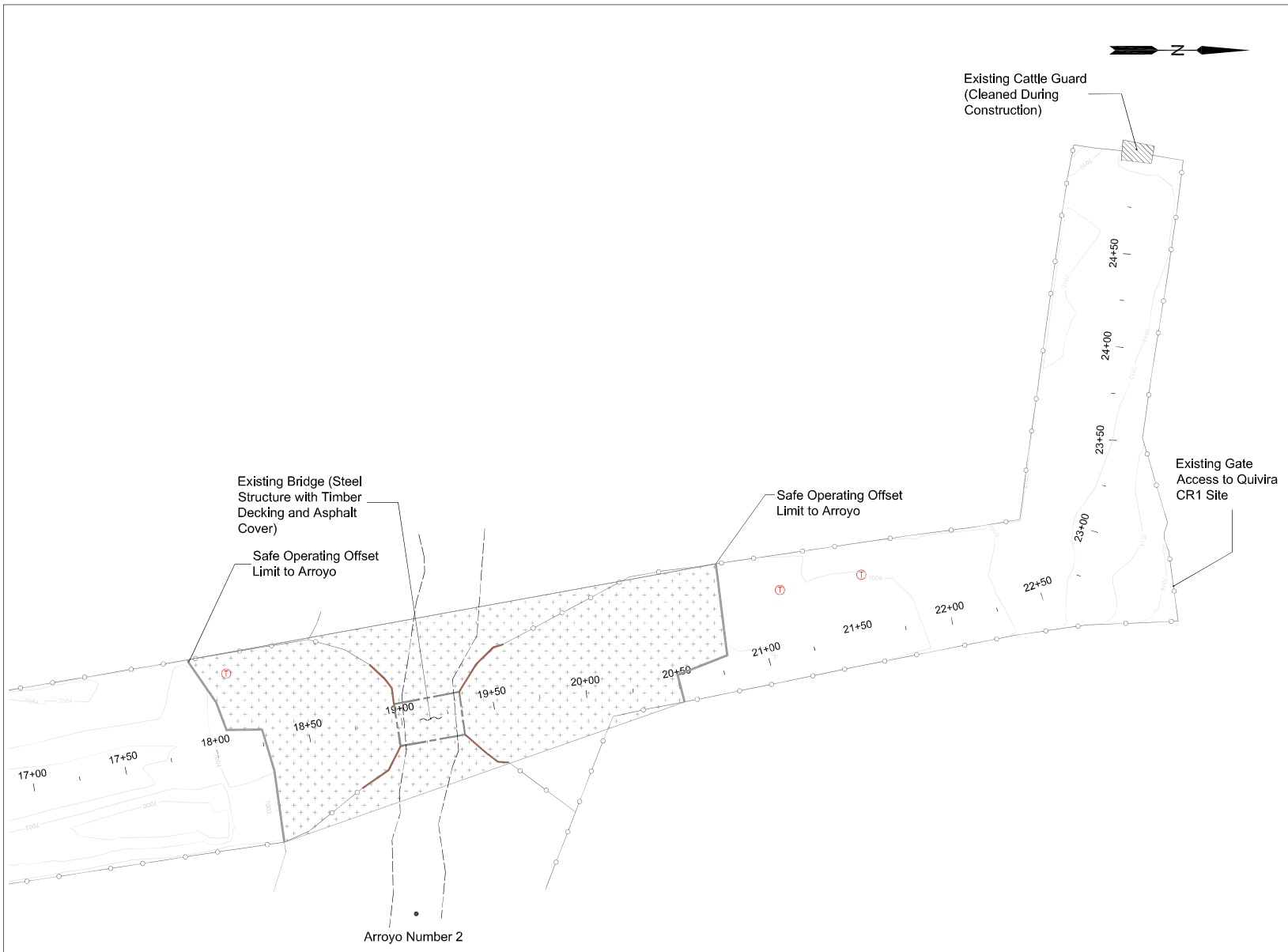
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Excavation Conditions Station 13+00 to 19+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: EX 4	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
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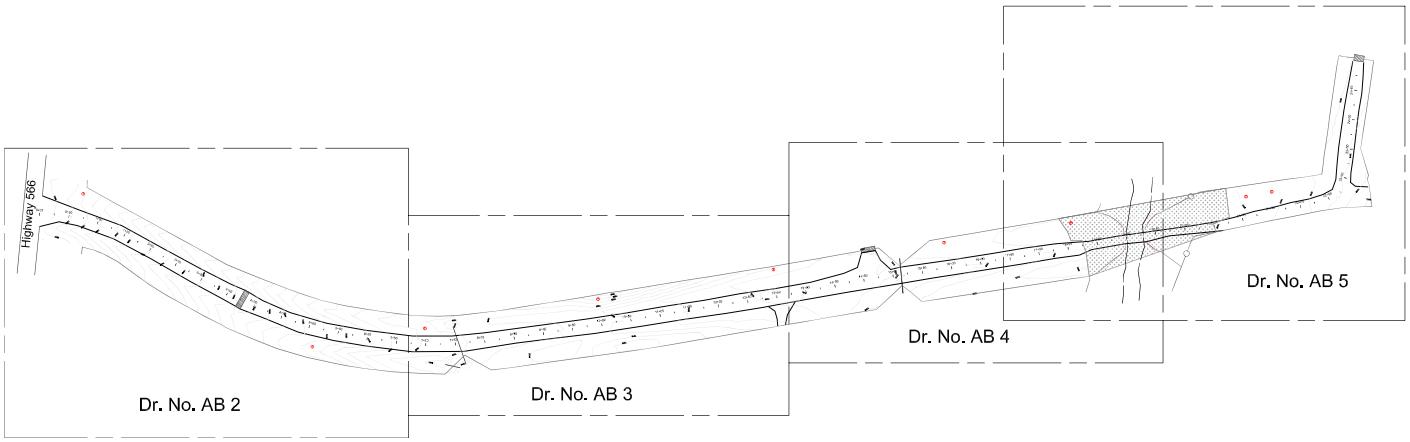
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Excavation Conditions Station 17+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.:EX 5	



General Notes

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- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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- Contour
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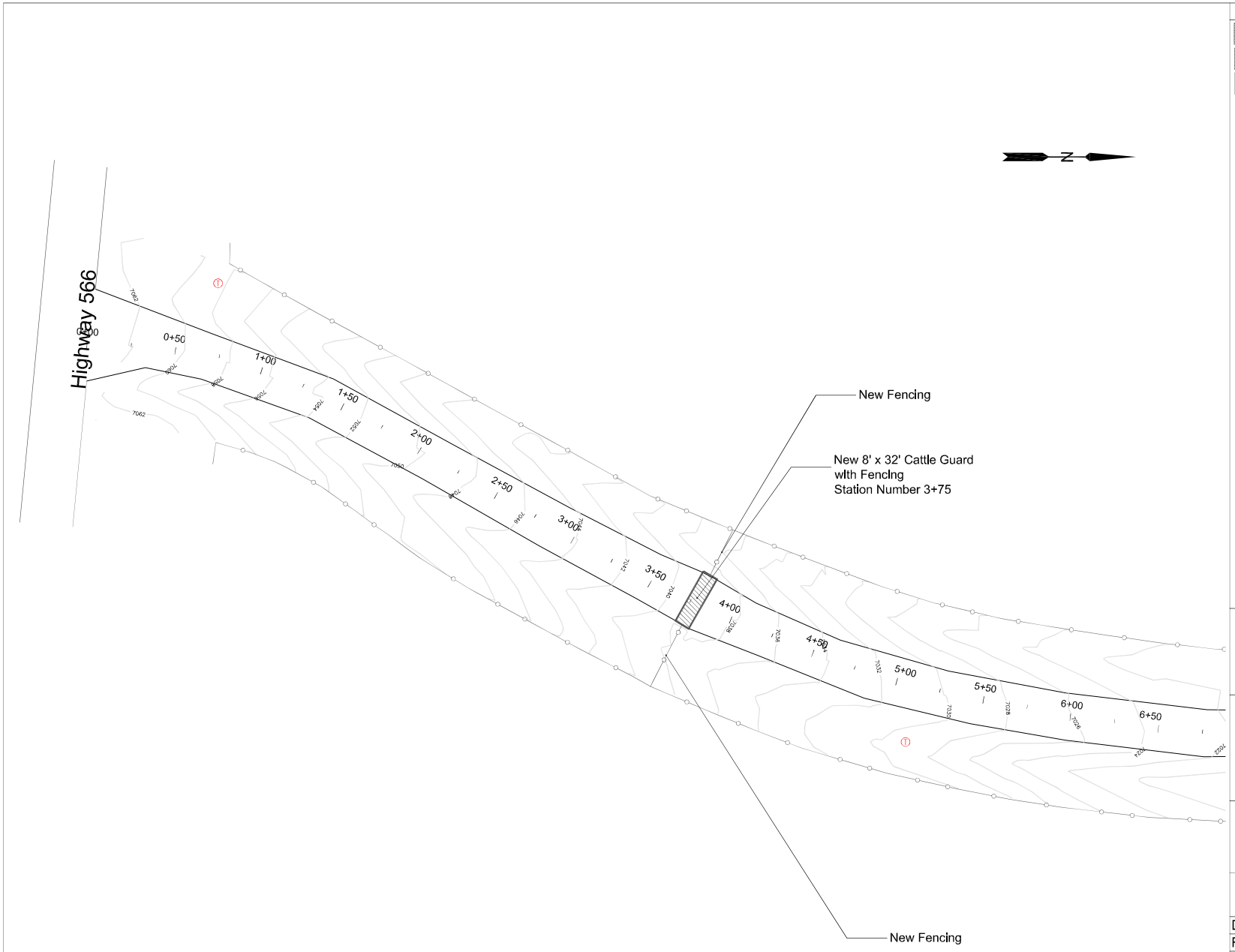
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: As Built
Station 0+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: AB 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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0 25 50 75

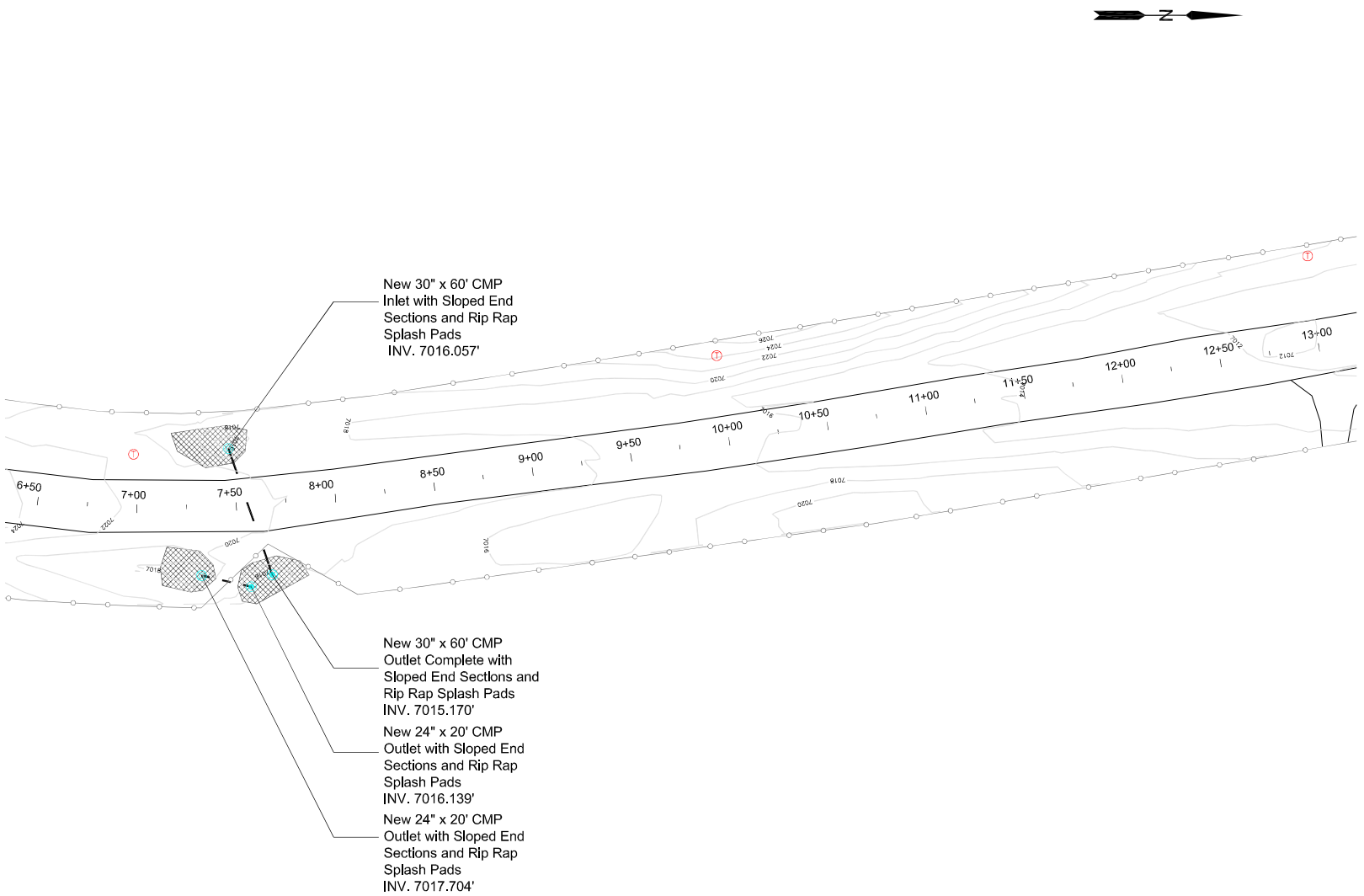
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: As Built
Station 0+00 to 6+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: AB 2	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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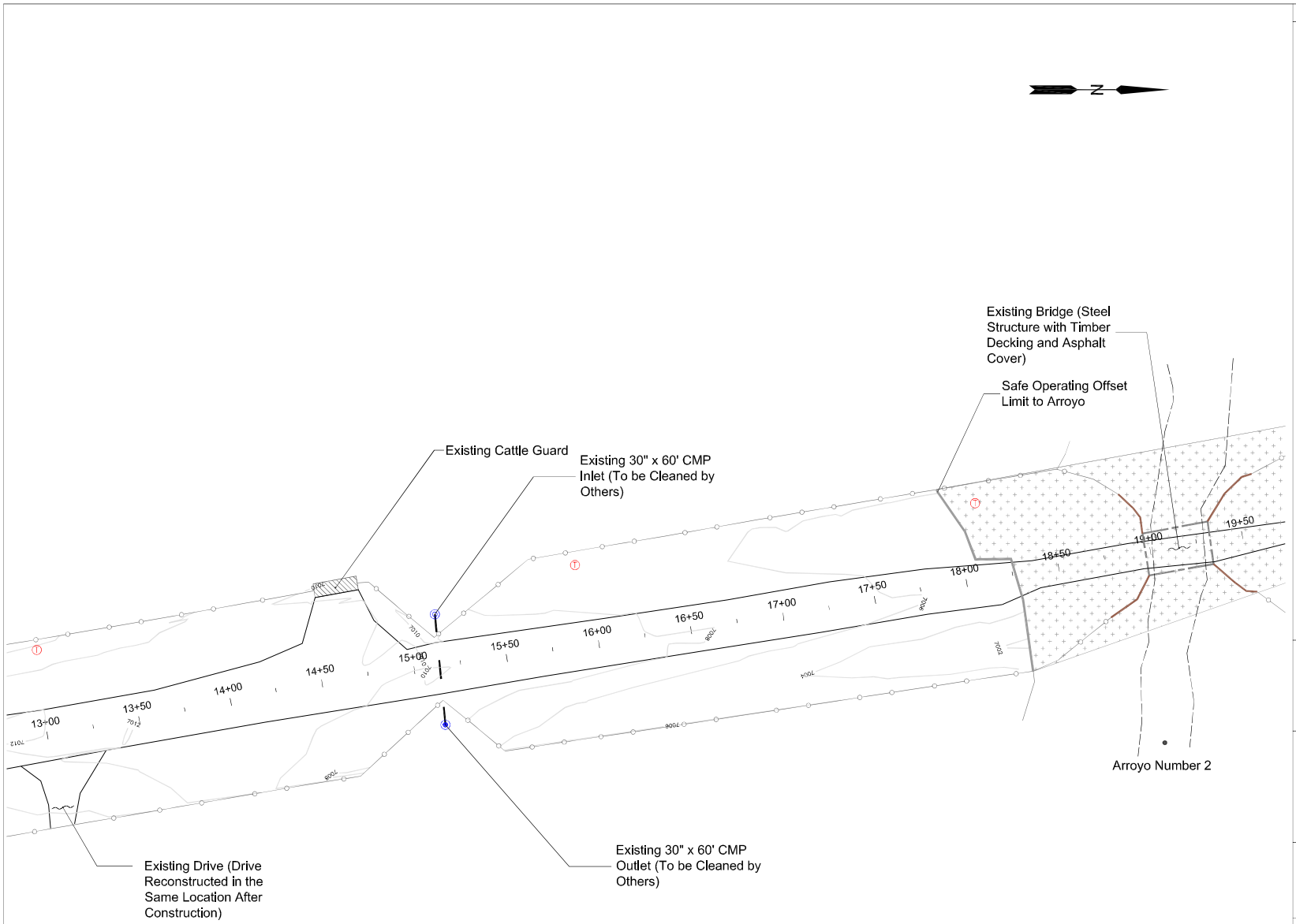
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: As Built
Station 6+50 to 13+00

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: AB 3	



General Notes

- Rip Rap
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- Approx. Seeded Area
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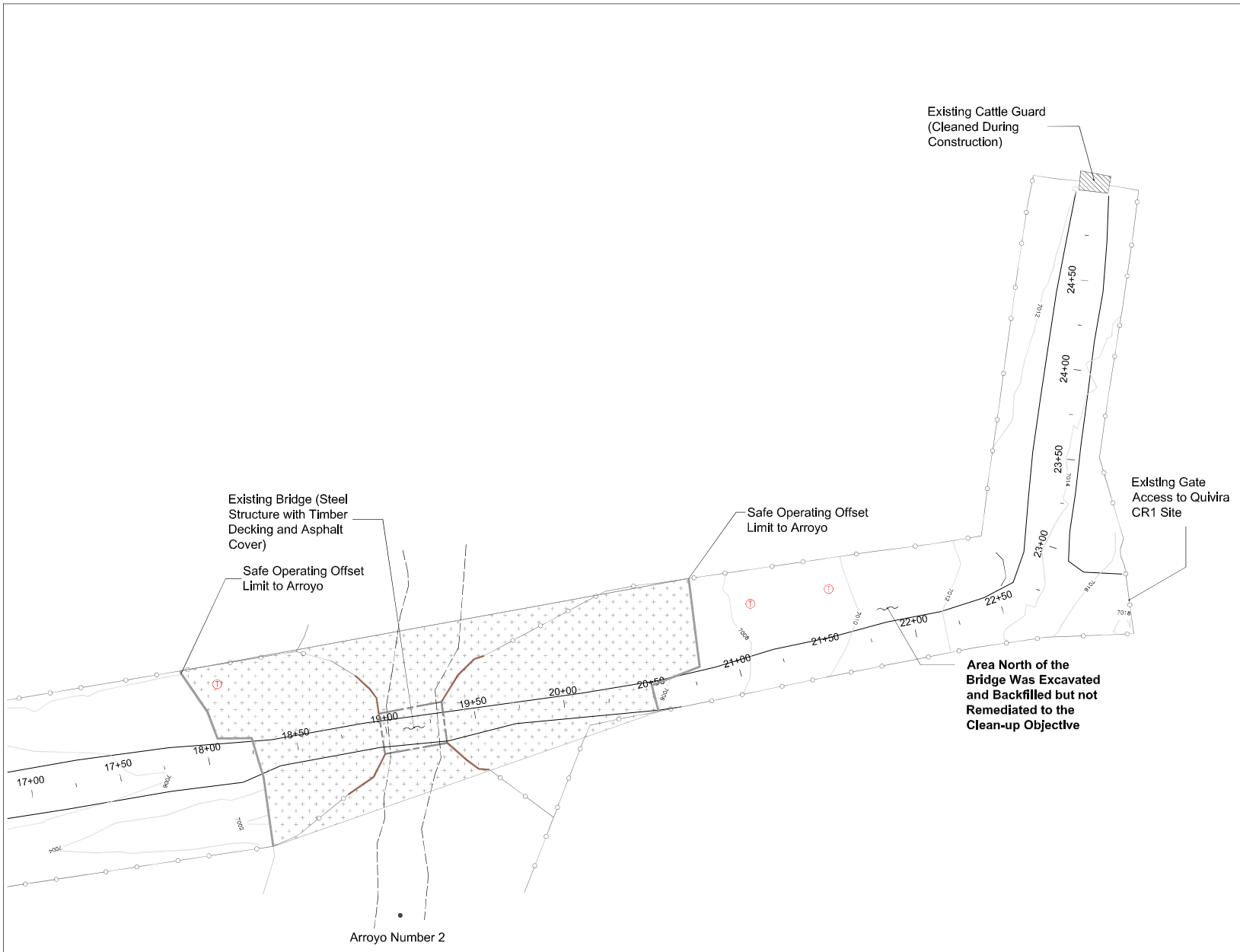
CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: As Built
Station 13+00 to 19+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: AB 4	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
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1" on original

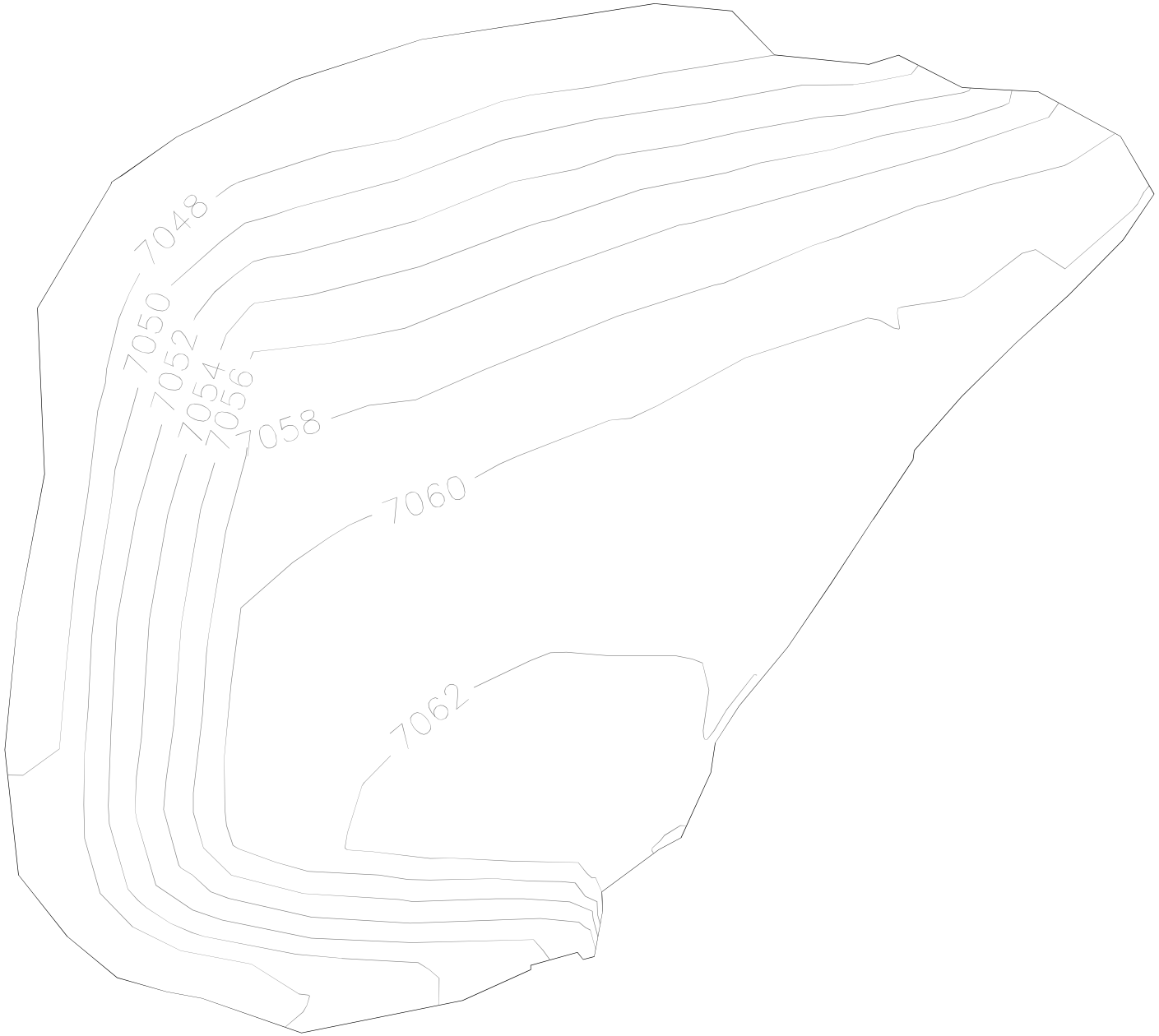
CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:

Project:
Red Water Pond Road Removal Action

Title:
As Built
Station 17+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: AB 5	



General Notes

Contour
Culvert
Fence
Bridge
Wing Walls
Road and Driveway
Arroyo Number 2
Safe Operating Offset Limit to Arroyo
Approx. RWPR Removal Action Boundary
Approx. Disposal Area Boundary

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.

0 25 50 75

1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: CR1 Disposal Area- Cap Sub Grade

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: CAP 1	

General Notes

Contour
Culvert
Fence
Bridge
Wing Walls
Road and Driveway
Arroyo Number 2
Safe Operating Offset Limit to Arroyo
Approx. RWPR Removal Action Boundary
Approx. Disposal Area Boundary

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.

0 25 50 75

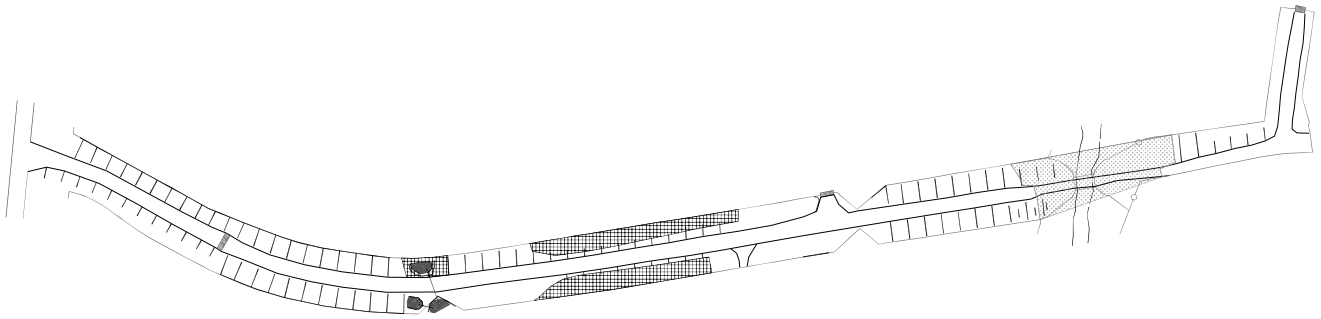
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

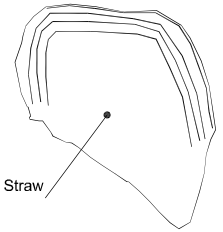
Project:
Red Water Pond Road Removal Action

Title: CR1 Disposal Area- Cap Finish Grade

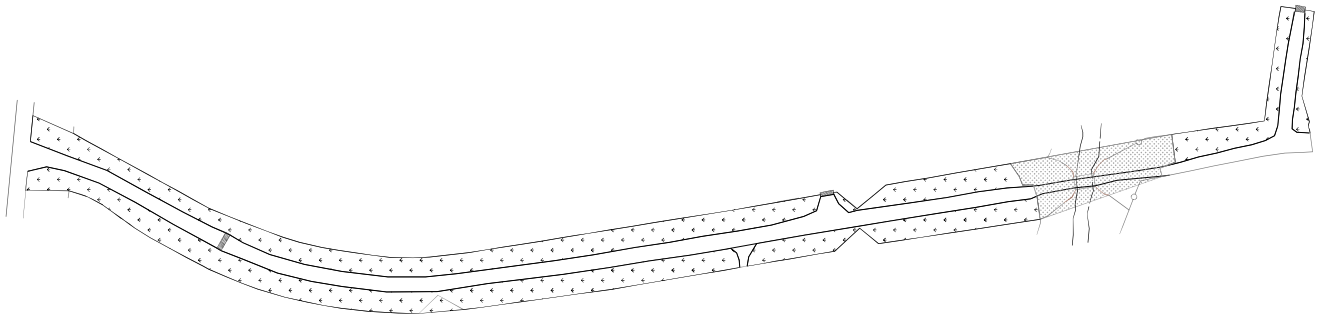
DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: CAP 2	



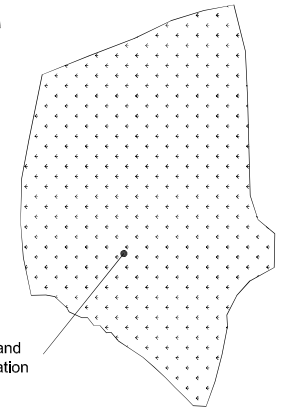
Storm Water Controls



Disposal Area With Straw Waddles



Seeded Areas



Revegetated Disposal Area and Surrounding Disturbed Vegetation

General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
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- Surface topography generated by field survey.
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- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field Interpretation and are hand sketched and are of questionable accuracy

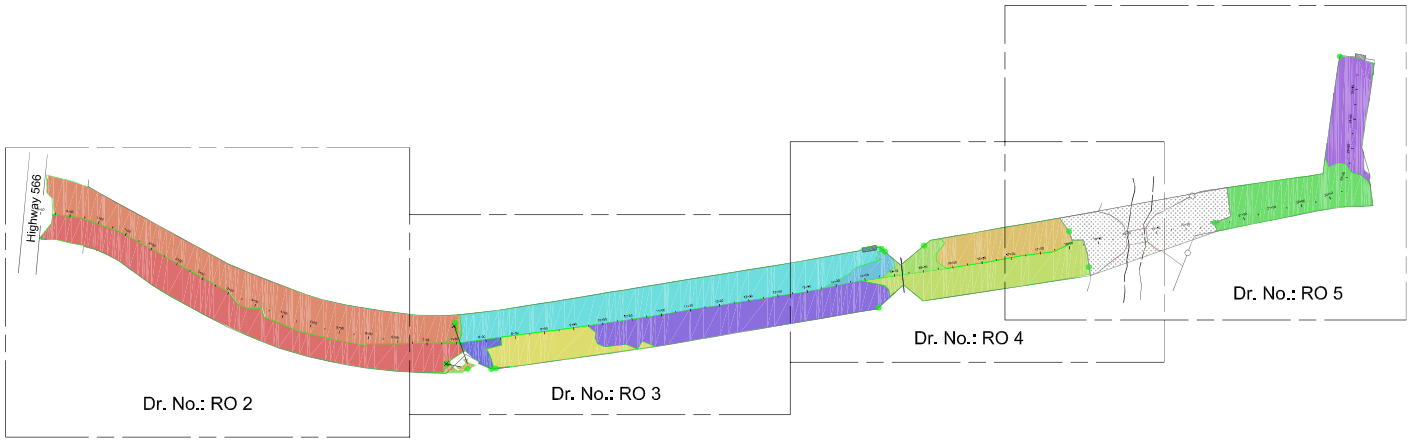
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Seeding and Storm Water Controls

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: SW 1	



General Notes

Rip Rap
Cattle Guard
Arroyo and Bridge Setback
Approx. Seeded Area
Approx. Straw Matting
Contour
Culvert
Fence
Bridge
Wing Walls
Road and Driveway
Arroyo Number 2
Safe Operating Offset Limit to Arroyo
Approx. RWPR Removal Action Boundary
Approx. Disposal Area Boundary
Water Outlet Point

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy
- Each Water Shed Zone is Represented by a Different Shade Color, These Zones Flow Towards The Green Circles in Each Zones and This Is Where the Water Exits That Area

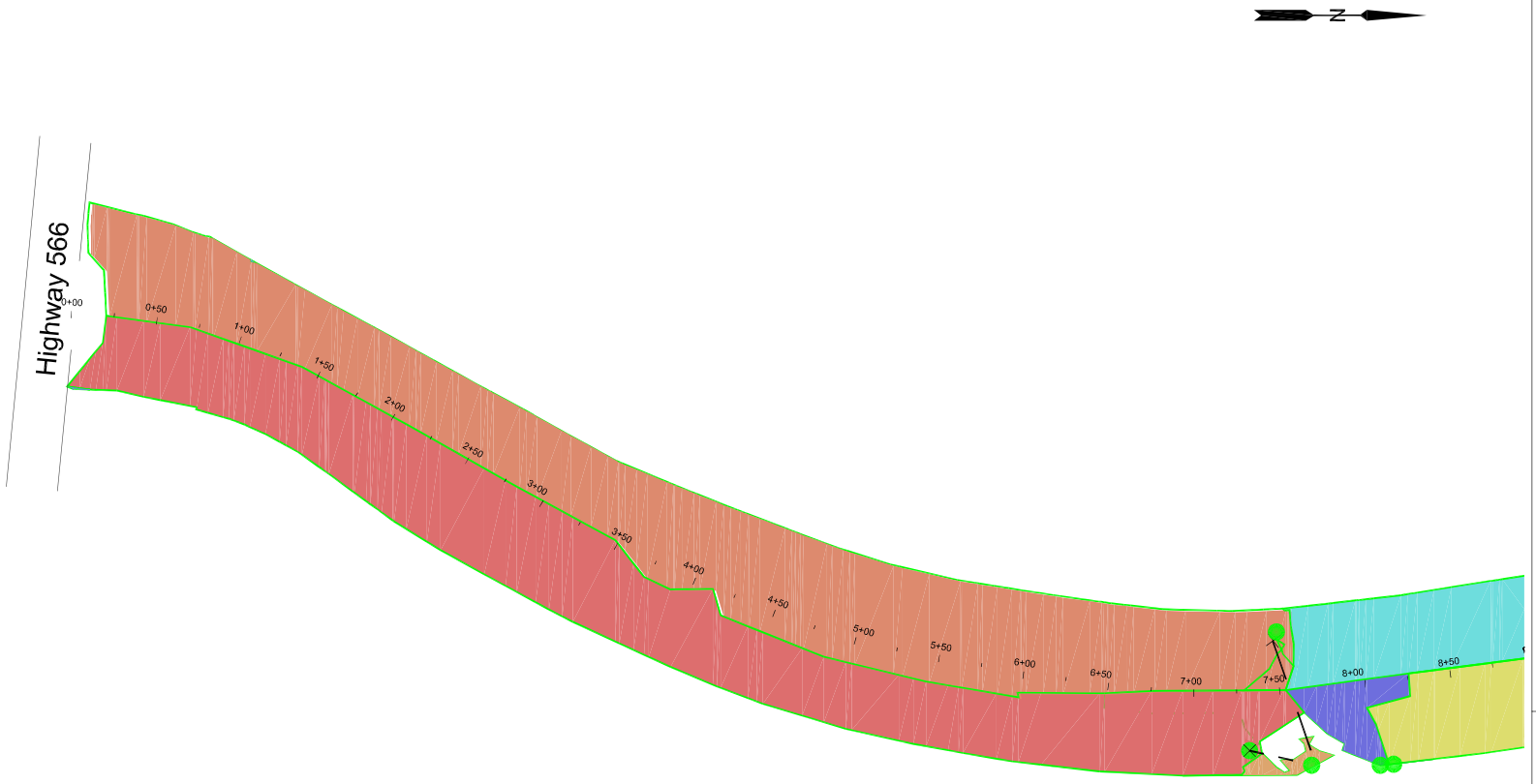
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Runoff Tracking As Built Station 0+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: RO 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Water Outlet Point

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy
- Each Water Shed Zone is Represented by a Different Shade Color, These Zones Flow Towards The Green Circles in Each Zones and This Is Where the Water Exits That Area

0 25 50 75

1" on original

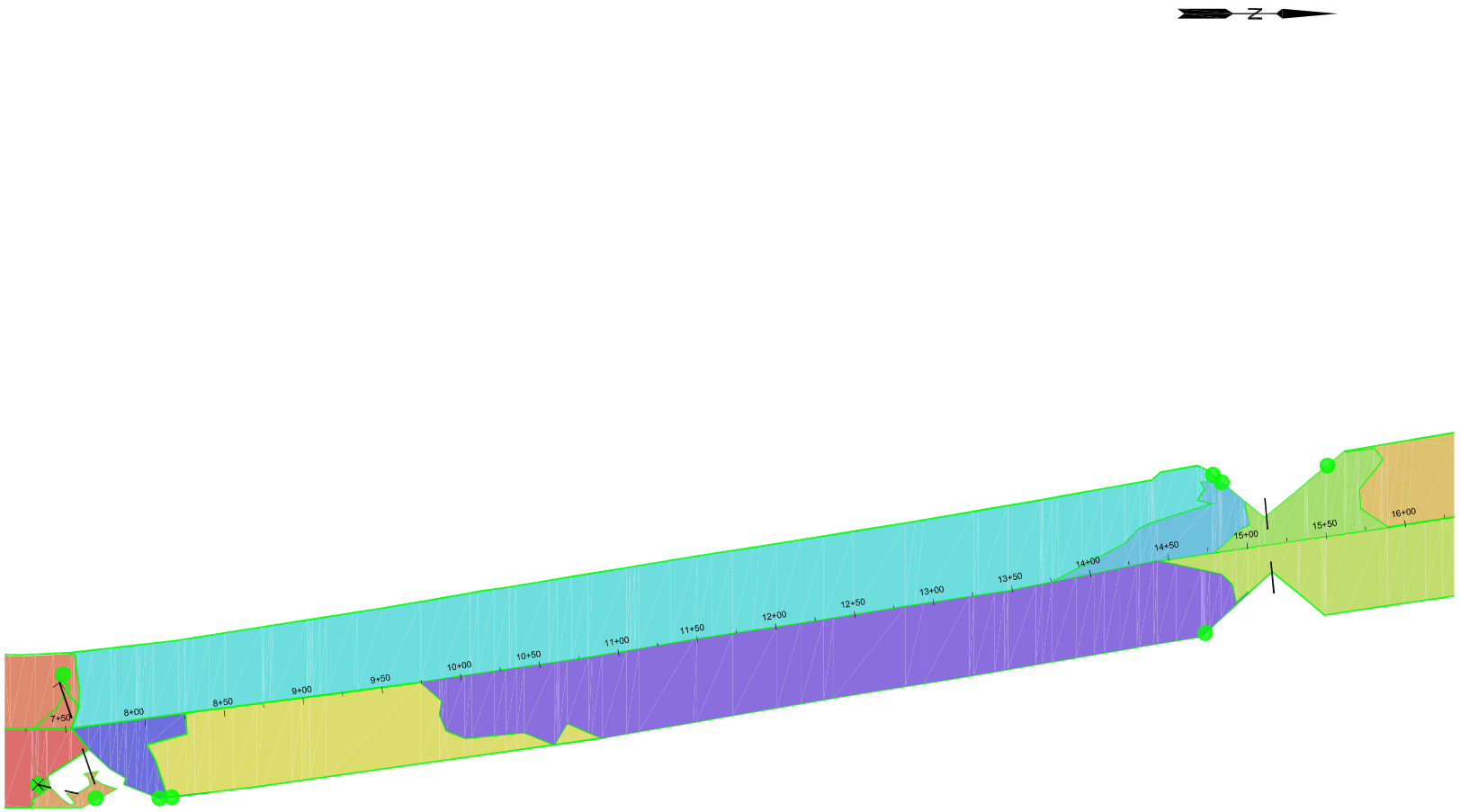
CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:

Red Water Pond Road Removal Action

Title: Runoff Tracking As Built Surface Station 0+00 to 8+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: RO 2	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Water Outlet Point

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
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- Each Water Shed Zone is Represented by a Different Shade Color, These Zones Flow Towards The Green Circles in Each Zones and This Is Where the Water Exits That Area

0 25 50 75

1" on original

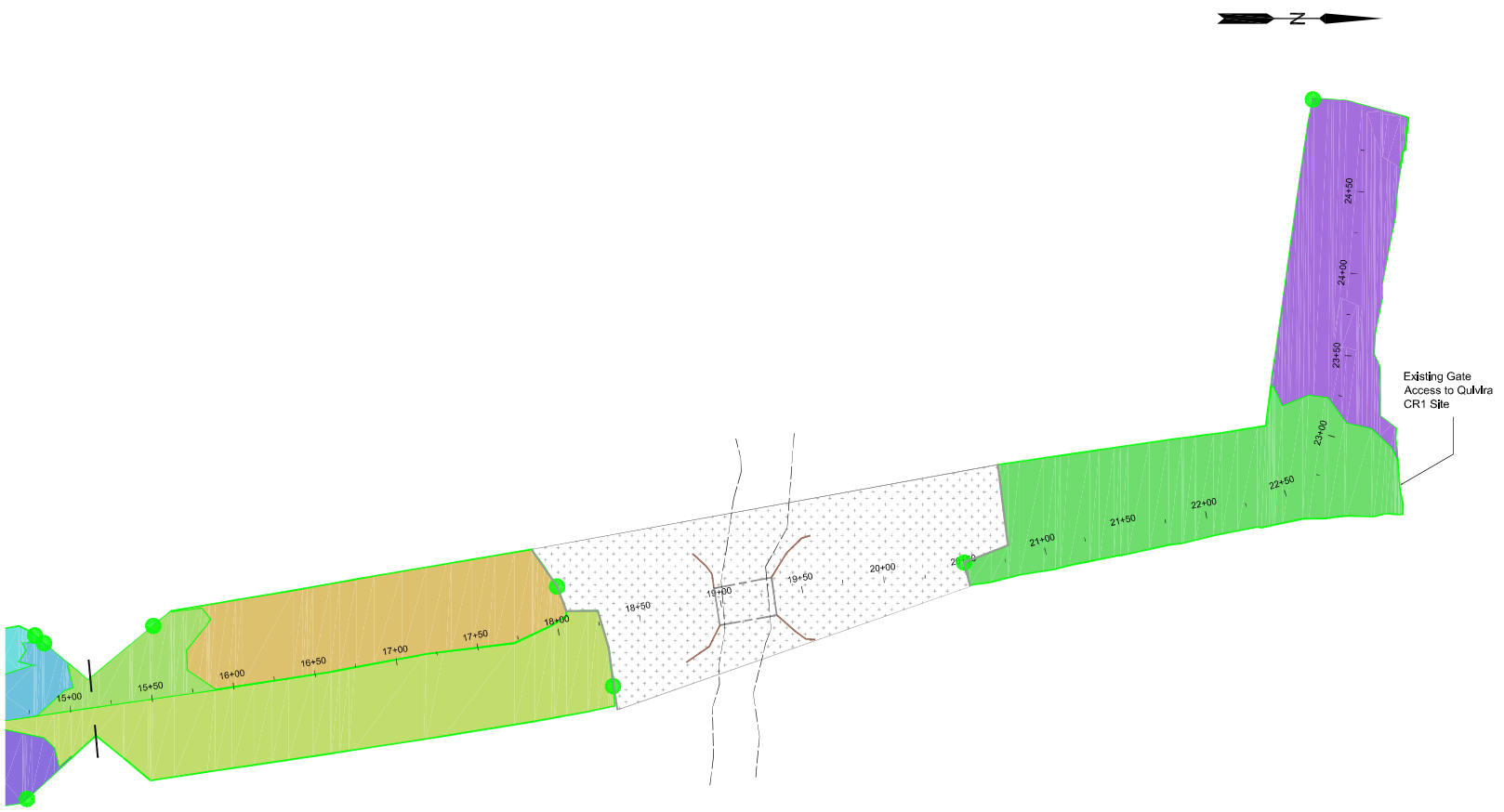
CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:

Red Water Pond Road Removal Action

Title: Runoff Tracking As Built Surface Station 8+50 to 16+00

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: RO 3	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Water Outlet Point

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy
- Each Water Shed Zone is Represented by a Different Shade Color, These Zones Flow Towards The Green Circles in Each Zones and This Is Where the Water Exits That Area

0 25 50 75

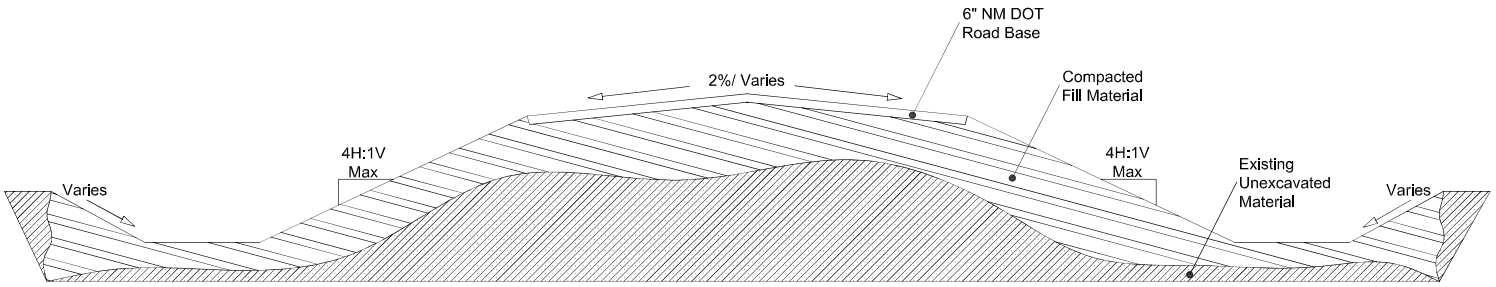
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

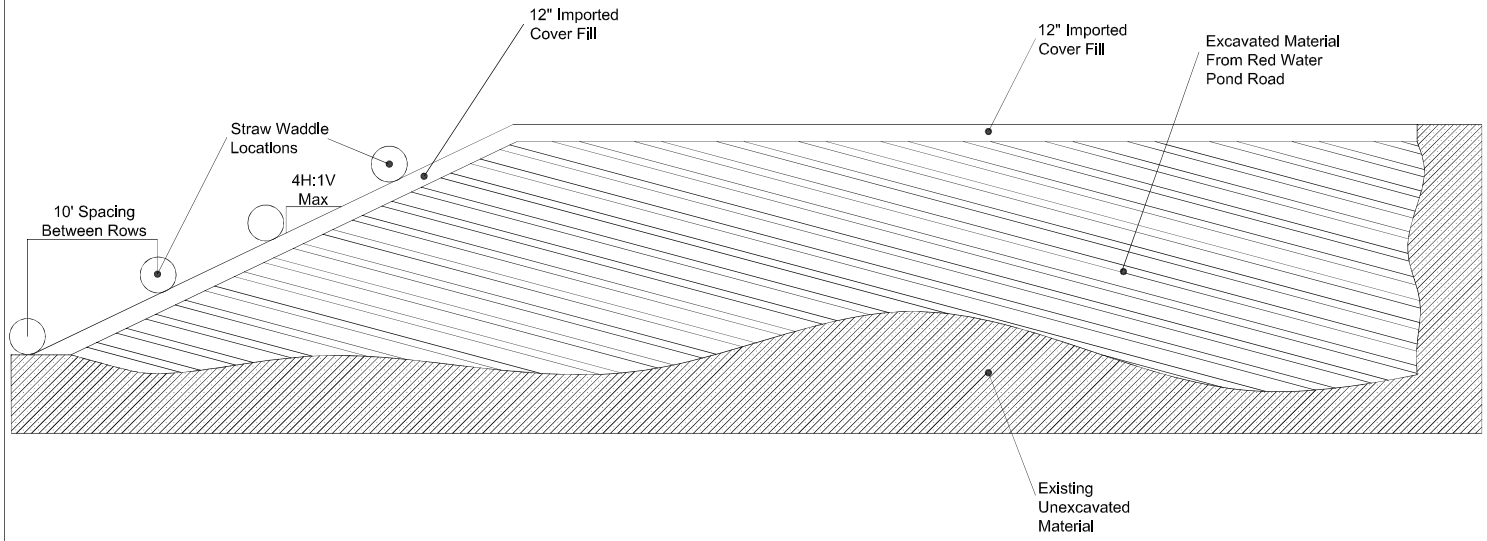
Project:
Red Water Pond Road Removal Action

Title: Runoff Tracking As Built Surface Station 15+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: RO 4	



Typical Road Cross Section Detail
(Exaggerated and Not To Scale)



Disposal Area Cap Cross Section Detail
(Exaggerated and Not To Scale)

General Notes

- Rip Rap
- Approx. Seeded Area
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

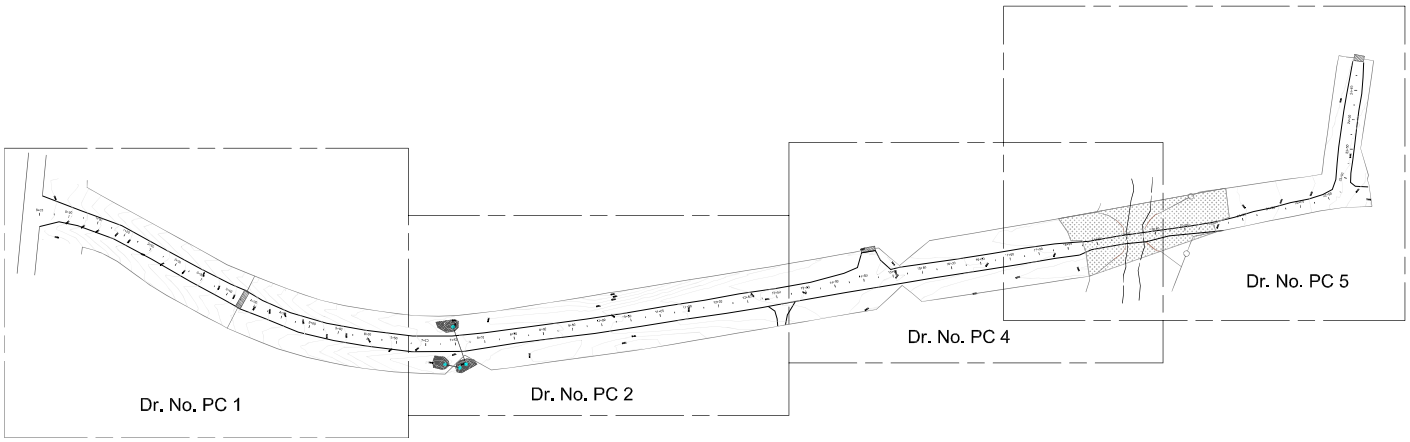
- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Disposal Area Cap and Road Cross Sections

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: DET 1	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy

1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Post Construction Photos Station 0+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: PC 1	

General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy

0 25 50 75

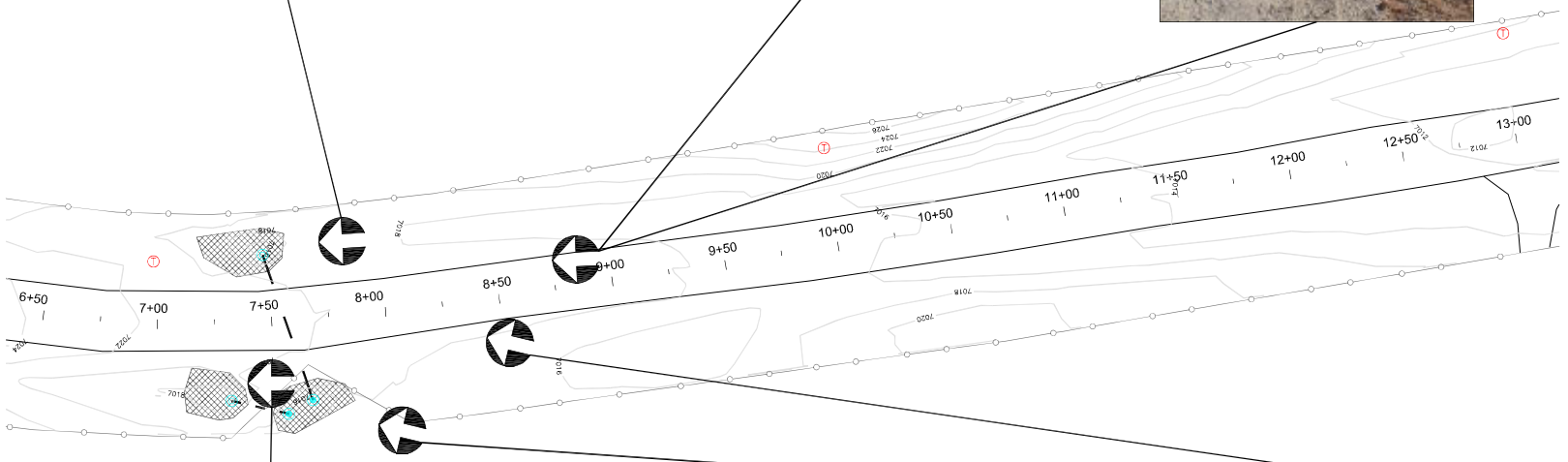
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Post Construction Photos Station 0+00 to 6+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: PC 2	



General Notes

- Rip Rap
- Approx. Seeded Area
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
- New Mexico State Plane Coordinates NAD 83.
- Areas or Boundaries shown here are original boundaries which were moved slightly during RWPR removal action
- Some boundaries are based on field interpretation and are hand sketched and are of questionable accuracy

0 25 50 75

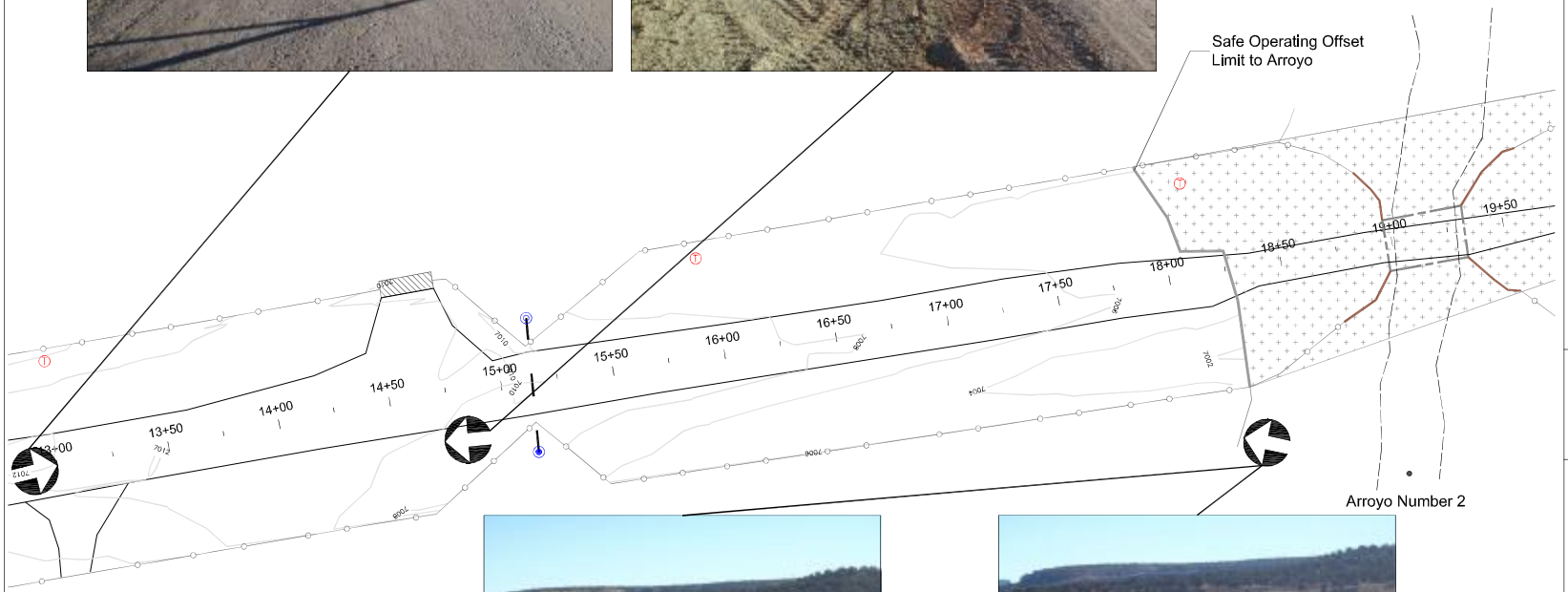
1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Post Construction Photos Station 6+50 to 13+00

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: PC 3	



General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

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0 25 50 75

1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:
Red Water Pond Road Removal Action

Title: Post Construction Photos Station 13+00 to 19+50

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.:PC 4	

General Notes

- Rip Rap
- Cattle Guard
- Arroyo and Bridge Setback
- Approx. Seeded Area
- Approx. Straw Matting
- Contour
- Culvert
- Fence
- Bridge
- Wing Walls
- Road and Driveway
- Arroyo Number 2
- Safe Operating Offset Limit to Arroyo
- Approx. RWPR Removal Action Boundary
- Approx. Disposal Area Boundary
- Power Pole
- New CMP Inlet
- New CMP Outlet
- Existing CMP Inlet
- Existing CMP Outlet

- Surface topography generated by field survey.
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0 25 50 75

1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

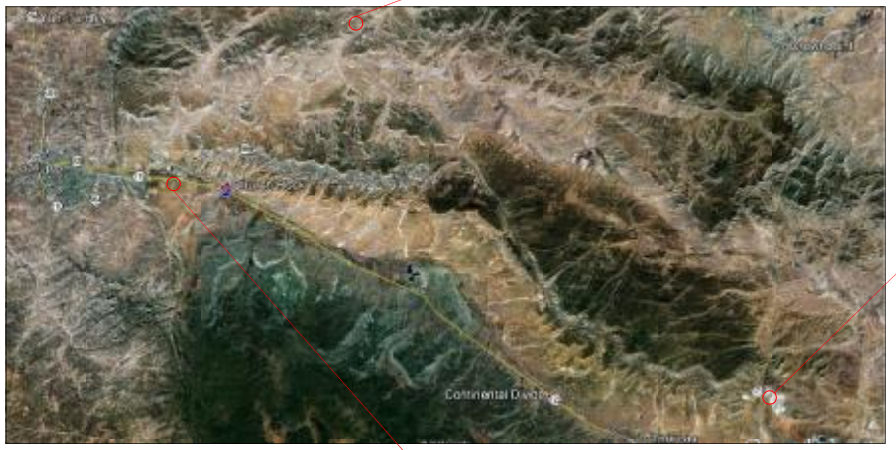
Project:

Project:
Red Water Pond Road Removal Action

Title: Post Construction Photos Station 17+00 to 24+80

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: PC 5	

Red Water Pond Road Site Location
Coordinates: 35°39'55.43" N
108°30'10.69"W



Gallup Sand and Gravel Pit
Coordinates: 35°26'36.44" N
108°7'43.90"W
Material taken from this source location was used as road base and rip rap

McConnel Pit
Coordinates: 35°31'43.53" N
108°38'39.51"W
Material taken from this source location was used a fill material

General Notes

Rip Rap
Approx. Seeded Area
Cattle Guard
Arroyo and Bridge Setback
Approx. Straw Matting
Contour
Culvert
Fence
Bridge
Wing Walls
Road and Driveway
Arroyo Number 2
Safe Operating Offset Limit to Arroyo
Approx. RWPR Removal Action Boundary
Approx. Disposal Area Boundary
Power Pole
New CMP Inlet
New CMP Outlet
Existing CMP Inlet
Existing CMP Outlet

- Surface topography generated by field survey.
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1" on original

CRA Services
200 W. Allegan St. Suite 300
Plainwell, Mi. 49080

Project:

Project:
Red Water Pond Road Removal Action

Title:
Site and Barrow Pit Locations

DR. By: CG	Date: 12/19/2012
Rev By: SJ	Date: 12/19/2012
Apprv. By: KB	Date: 12/19/2012
Dr. No.: PIT 1	