From: Anthony Bell <anthony.bell@spower.com>
Sent: Friday, January 25, 2019 1:54 PM
To: Patrick White
Cc: Wanda Parrish; Charlie Payne; Daniel Menahem; Ben Saunders
Subject: FW: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015
Attachments: Johnson 2013 TetraTech BAS Report.pdf; PV EHS One pager Final.pdf

Patrick,

Please share the attached Tetra Tech BAS study with Mr. Hammond, I believe it fits the description of the specific study he keeps asking for: PV panels were run-over with a sheepsfoot compactor and the broken fragments were then analyzed with the EPA's TCLP and STLC procedures.

The study found broken module pieces remain encapsulated (the glass-laminate-glass bond is maintained). The glass-laminate-glass "sandwich" remains intact. Although the panels broke when the cleats of the sheepsfoot cut-out some pieces, these cut-out pieces still remained as intact "sandwiches" (the glass-laminate-glass bond held). Roughly, 1/3 of the panel broke into smaller sandwiches, while 2/3 remained as an intact panel. The broken pieces, the smaller sandwiches, were then analyzed using the EPA's TCLP and STLC procedures and were found to be non-hazardous.

To me, this seems to be the desired methodology Mr. Hammond described in his conversation with Dr. Fthenakis (which he mentioned below) so please include him on the distribution when you forward this to Dewberry and the rest of your team internally.

Also, please share Ricky's response to the inquiry regarding the tornado event in California : " First Solar recycled approximately 135,000 modules from the tornado event. The site owner organized the site cleanup and disposed of debris that was not recycled, recovering both large and small pieces. Composite sampling of soil and module pieces from the tornado event passed TCLP. An environmental NGO contacted Bureau of Land Management and reported no indication of soil contamination (http://www.basinandrangewatch.org/DesertSunlight.html)"

I know Mr. Hammond had tried to contact First Solar with information regarding this specific tornado event with no response.

Also, as an aside, please note that the owner of the project was able to recycle 135,000 panels from this event.

Lastly, since Mr. Hammond continues to reference Caribbean hurricane events, I wanted to share success stories of many PV installations that survive these storms with no, or minimal damage:
http://gamechangesolar.com/news-gamechange-hurricane-michael.php
http://energia.pr.gov/wp-content/uploads/2017/12/IN20170002A59-COMENTARIOS-Horizon-Energy-LLC.pdf
https://sonnedix.com/impact/give-it-up-for-puerto-rico/

I understand that the conditions prohibit the use of Cadmium Telluride panels, but seeing as this email went out before the Planning Commission decision I still wanted to see it through and get the facts out there.

Best,

Anthony

From: Parikhit Sinha <Parikhit.Sinha@FIRSTSOLAR.COM>
Sent: Wednesday, January 16, 2019 6:02 AM
To: Anthony Bell <anthony.bell@spower.com>
Cc: Becky Campbell <Rebecca.Campbell@firstsolar.com>; John Sakers <John.Sakers@FIRSTSOLAR.COM>; Daniel Menahem <dmenahem@spower.com>
Subject: RE: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Hi Anthony.

For item 1 below, encapsulation refers to the integrity of the glass-laminate-glass bond that sandwiches the semiconductor. Please see the attached TetraTech BAS report which indicates broken module pieces remain encapsulated (glass-laminate-glass bond is maintained; p. 1) after severe crushing by a landfill compactor. The samples pass TCLP.

For item 2 below, First Solar recycled approximately 135,000 modules from the tornado event. The site owner organized the site cleanup and disposed of debris that was not recycled, recovering both large and small pieces. Composite sampling of soil and module pieces from the tornado event passed TCLP. An environmental NGO contacted Bureau of Land Management and reported no indication of soil contamination (http://www.basinandrangewatch.org/DesertSunlight.html)

For item 3 below, use of metals in PV modules is commonplace, either in the semiconductor or electrical connections between solar cells. PV modules are designed and tested for long-term durability, and operations and maintenance procedures are used to identify and remove non-functioning modules from the field (see EHS one-pager attached).

Thanks.
Ricky

From: Anthony Bell <anthony.bell@spower.com>
Sent: Monday, January 14, 2019 4:36 PM
To: Parikhit Sinha <Parikhit.Sinha@FIRSTSOLAR.COM>
Subject: RE: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Excellent, thank you. We appreciate the help.

From: Parikhit Sinha <Parikhit.Sinha@FIRSTSOLAR.COM>
Sent: Monday, January 14, 2019 3:59 PM
To: Anthony Bell <anthony.bell@spower.com>

Subject: RE: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Hi Anthony. I am inquiring internally and will get back to you mid-week.

Thanks.
Ricky

From: Anthony Bell <anthony.bell@spower.com>
Sent: Monday, January 14, 2019 8:56 AM
To: Parikhit Sinha <Parikhit.Sinha@FIRSTSOLAR.COM>
Subject: FW: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Hello Ricky,

Hope all is well. I was wondering if you could provide some further assistance and insight for our project, specifically on the Desert Sunlight project hit by a tornado. David Hammond (see his entire email below) is one of the citizens who continuously brings up the Cadmium Telluride issue. He insists that the encapsulation of CdTe does not work and requires proof. Several times he has asked for a study which, as afar a I know, does not exist where broken panels are taken and the remaining CdTe is extracted from the panel to calculate how much was lost during breakage. Are you aware of any such study?
It would be incredibly helpful to our efforts if you could provide the evidence Mr. Hammond is pressing for in the form of any of the below:
1) Evidence that CdTe remains encapsulated and bonded to the glass even during breakage
2) Data (perhaps soil samples) that no CdTe was released into the soil during this tornado event
3) A statement from First solar regarding the incident below, any environmental concerns, or a statement on encapsulation in general.

Thanks again for all the help, as always,

Anthony Bell
Permitting & Environmental Compliance Analyst
M: 801.557.7971

S·POWER
An AES and AIMCo Company

From: Daniel Menahem <dmenahem@spower.com>
Sent: Sunday, January 13, 2019 4:27 PM
To: Garret Bean <gbean@spower.com>; Ben Saunders <ben.saunders@spower.com>; Anthony Bell <anthony.bell@spower.com>
Subject: Fwd: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Daniel Menahem | Sr Manager, Solar Development
O: 801.679.3513
M: 202.390.7772

S•POWER
Sustainable Power Group
2180 South 1300 East, Suite 600
Salt Lake City, UT 84106
www.sPower.com

Begin forwarded message:

> **From:** Charlie Payne <cpayne@hirschlerlaw.com>
> **Date:** January 13, 2019 at 16:04:43 MST
> **To:** "'Daniel Menahem (dmenahem@spower.com)'" <dmenahem@spower.com>
> **Subject: FW: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015**
>
> See below
>
> Sent with BlackBerry Work
> (www.blackberry.com)
>
> From: Timothy J. McLaughlin
> <McLaughlinTJ@Spotsylvania.va.us<mailto:McLaughlinTJ@Spotsylvania.va.us>>
> Date: Sunday, Jan 13, 2019, 5:48 PM
> To: Charlie Payne <cpayne@hirschlerlaw.com<mailto:cpayne@hirschlerlaw.com>>
> Subject: [EXTERNAL] Fwd: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015
>
> Sent from my iPad
>
> Begin forwarded message:
>
> From: Dave Hammond
> <davehammond@gmail.com<mailto:davehammond@gmail.com>>
> Date: January 13, 2019 at 5:37:39 PM EST
> To: <grenewpc@gmail.com<mailto:grenewpc@gmail.com>>,
> <2012sheriffsmith@gmail.com<mailto:2012sheriffsmith@gmail.com>>, Travis Bullock
> <TravAAU@cox.net<mailto:TravAAU@cox.net>>,
> <berkeleymaddox@gmail.com<mailto:berkeleymaddox@gmail.com>>,
> <spotsysalem@gmail.com<mailto:spotsysalem@gmail.com>>
> Cc: Greg Benton <TBenton@spotsylvania.va.us<mailto:TBenton@spotsylvania.va.us>>,

"Paul D. Trampe"
<PTrampe@spotsylvania.va.us<mailto:PTrampe@spotsylvania.va.us>>,
<cyakabouski@spotsylvania.va.us<mailto:cyakabouski@spotsylvania.va.us>>,
<kmarshall@spotsylvania.va.us<mailto:kmarshall@spotsylvania.va.us>>, "Timothy J. McLaughlin"
<McLaughlinTJ@spotsylvania.va.us<mailto:McLaughlinTJ@spotsylvania.va.us>>, David Ross <David.Ross@spotsylvania.va.us<mailto:David.Ross@spotsylvania.va.us>>,
<Gskinner@spotsylvania.va.us<mailto:Gskinner@spotsylvania.va.us>>,
<BOS@spotsylvania.va.us<mailto:BOS@spotsylvania.va.us>>, Wanda Parrish
<wparrish@spotsylvania.va.us<mailto:wparrish@spotsylvania.va.us>>, Patrick White
<pwhite@spotsylvania.va.us<mailto:pwhite@spotsylvania.va.us>>, Paulette Mann
<pmann@spotsylvania.va.us<mailto:pmann@spotsylvania.va.us>>,
<planning@spotsylvania.va.us<mailto:planning@spotsylvania.va.us>>
Subject: Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015

Spotsylvania Planning Commissioners --

I have been looking for months for scientific evidence that the "encapsulation" that sPower claims has been scientifically proven. They claim that a single sheet of plastic attached to the bottom layer of glass prevents the panel from shattering, and that all of the Cadmium remains inside a broken solar panel. Their analogy is a car windshield that will break, but not shatter.

I presented my 'nightmare scenario' to you several weeks ago in which a tornado or other severe weather event hits the solar power plant and the panels are destroyed and strewn over a large debris field. Then, severe contamination of the soil and water occurs because the cleanup effort is limited to picking up the large pieces of glass, and not every piece of debris. If the Cadmium is not effectively "encapsulated", then a very rigorous cleanup effort will be required, not a quick cleanup of the big stuff.

I found that a tornado has indeed hit a large solar power plant containing Cadmium Telluride thin-film solar panels manufactured by First Solar. The facility is called Desert Sunlight, it is located in the Mojave Desert in California, and has a capacity of 550 MW. An EF-0 tornado with a windspeed above 80 mph hit a corner of the facility and destroyed 170,000 CdTe solar panels.

The following document contains some information about the incident and a picture of the damage. NextEra Energy described the incident in an article about their role in helping to clean up the damage, since they co-own the facility.

Tornado Destroys 170,000 Cadmium Telluride Solar Panels - Desert Sunlight 2015<https://drive.google.com/open?id=1GCBIxf8PyWQk0dXRsXfIih7B7hcGFmtb>

You can see from the close-up view of the damage that there are pieces of broken solar panels laying on the ground.

I have not been able to find any more information about this incident. I asked the

Bureau of Land Management for information a few months ago since the facility is located on BLM land, but they have not responded to my request. I have also asked First Solar for information on the 'encapsulation' that has been claimed by the solar industry (including the North Carolina Clean Technology Center that sPower referenced in their Cadmium Safety document), but First Solar has not responded with any information. First Solar not only manufactured the solar panels used, but they are also the operators of the site. They are very well aware of this incident, the damage that was caused, and any environmental problems that were caused. However, they are not talking.

At the last Planning Commission hearing, Dr. Fthenakis (sPower's solar expert) stated that he has done extensive research about the encapsulation of Cadmium Telluride inside the two layers of glass. After the meeting, I asked Dr. Fthenakis for any references that show the Cadmium remains inside the solar panels following a catastrophic weather event like a tornado, hurricane, etc. He told me that all of his research has been done for encapsulation of Cadmium during a fire, and that he is not aware of any work that evaluates encapsulation efficiency following a severe storm. sPower included Dr. Fthenakis' report on Cadmium encapsulation during a fire in their Cadmium Safety report.

Note that the tornado that hit Desert Sunlight was the lowest category for a tornado (EF-0) and it still destroyed 170,000 solar panels. It does not take a major hurricane, like those that his the Caribbean, to cause extensive damage. There was a quote in the NextEra Energy article: “We were lucky that the tornado only impacted the corner of the facility, the extent of damage was significant.”

Once again, I ask you to prohibit the use of all thin-film type solar panels, which is what Culpeper County did in their Special Use Permit for the Greenwood Solar project that was recently approved. The risk of contamination of the soil and water is too great without clear scientific studies that prove that the Cadmium Telluride is effectively encapsulated in the solar panels after they are destroyed by a severe weather event.

Regards,
David Hammond
11416 Seymour Lane
Spotsylvania, VA 22551

--

Charles W. Payne, Jr.
D: 540.604.2108
cpayne@hirschlerlaw.com

Hirschler
725 Jackson Street, Suite 200 | Fredericksburg, VA 22401-5720
P: 540.604.2100 | F: 540.604.2101 | hirschlerlaw.com<http://www.hirschlerlaw.com>

TETRA TECH BAS

March 21, 2013

Dr. Parikhit (Ricky) Sinha, Ph.D.
First Solar
350 West Washington Street, Suite 600
Tempe, Arizona 85281

Subject: Photovoltaic (PV) Solar Panel Experiment Results

Dear Dr. Sinha:

Tetra Tech BAS (Tt BAS) has been retained by First Solar to conduct an experiment to determine if First Solar panels would produce hazardous leachate if disposed of in a municipal solid waste landfill. Of particular concern was the leaching potential of heavy metals, such as cadmium, from the PV panels after disposal. This experiment involved preparation of a test pad at a local landfill, crushing the panels with a typical municipal solid waste compactor, recovering all of the crushed pieces of the panels, performing grain size analyses of the pieces, performing TCLP and STLP laboratory testing of representative samples of the crushed panels, and preparation of this report.

A total of five photovoltaic solar panels manufactured by First Solar in Perrysburg, Ohio were chosen as subject panels. These panels were 2 feet by 3 feet 11 inches in size and weighed approximately 26.5 pounds each. The panels were model number 387. The panels consisted of three layers of different material and series of electrical connections. In the panel design, the semiconductor layer was encapsulated between two sheets of protective glass, and a polymeric adhesive was used to laminate the two sheets of glass together (Fig. 1). Based on gradation testing of the crushed panels, on average approximately one-quarter of panel pieces were smaller than 1 cm, and less than 5% of panel pieces were smaller than 1 mm. The glass-laminate-glass bond of individual broken panel pieces was maintained (i.e., individual panel pieces remained laminated). Based on TCLP and STLC test results for cadmium, lead, and other standard analytes, the crushed CdTe PV panels are non-hazardous.

Tetra Tech BAS
3822 E. University Drive | Phoenix, AZ 85034
Tel. 602.267.0336 Fax: 602.267.0446 www.tetratech.com

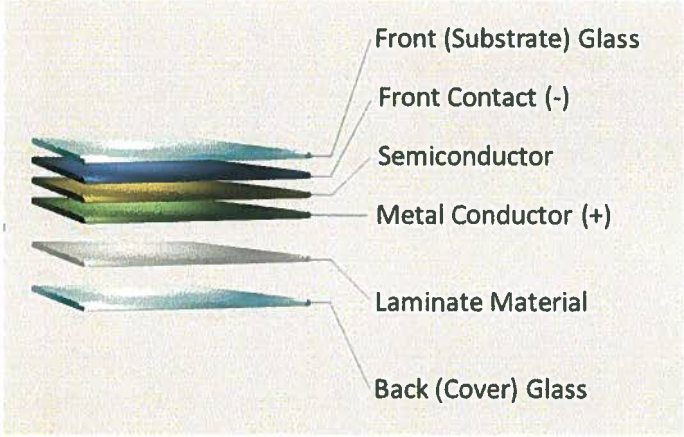


Figure 1. First Solar PV panel design

PV Panel Crushing

Five photovoltaic solar panels were crushed at the top of City of Glendale, Arizona, Municipal Solid Waste Landfill utilizing a compactor on December 6, 2012. The compactor used was a sheep's foot roller manufactured by Aljon, model 91K, with Caron cleats having a contact load of approximately 100,000 pounds (Picture #1). The PV panels were placed on top of a 22.5 x 40 foot tarp consisting of 60 mil. linear low density polyethylene (LLDPE) liner. The compactor made six passes over the test installation. The ground surface underlying the test installation consisted of loose soil which was firmer than the typical mixed waste conditions at the active face of a landfill. The residue from the crushed PV panels was collected and separately bagged for testing. This liner material is very flexible, however some puncturing of the liner did occur when the compactor rolled over the panels and a small amount of the crushed fines could not be recovered.

Picture #1 – Aljon model 91K compactor used to crush PV panels.

The procedure used to crush the PV panels may be considered a "worst case" for panel loading as the City of Glendale's landfill compactor is one of the largest and

heaviest compactors available on the market today. Landfills outside the United States typically do not have compaction equipment, and if landfill compaction equipment is available, the equipment is typically a track mounted dozer rather than a compactor. A dozer is typically used when the landfill can only afford one piece of equipment because the dozer can push the waste as well as compact the waste once it has been pushed into the active face. A track mounted dozer would be lighter than the City of Glendale's landfill compactor and therefore cause less damage to the PV panels.

After crushing the PV panels appeared as shown in Picture #2 (Additional pictures in Appendix A). Delamination of the panels did not occur unless impacted by one of the compactor's feet. The compactor's feet created a punch-out in the panel the approximate size of the foot. The PV panel material punched-out of the panels was recovered to the extent possible and consisted of the finer fraction of the overall sample.

Picture #2 – Crushed PV Panel with Compactor Foot Punch-out

After the PV panels were crushed the residues were brought to Hoque & Associates, Inc. (HA) soils laboratory for testing.

Gradation Tests

HA provided laboratory testing of the panel residue consisting of gradation tests. HA's laboratory received the crushed panel in two basic forms. The crushed PV panels consisted of fines that were not attached to the panel and larger pieces of broken glass (top and bottom layers) held together by the middle lamination. The upper layer was observed to be crushed more than the lower layer. It appeared that the material fractures followed the stress pattern imparted by the compactor feet.

In order to develop a gradation test procedure, HA adopted the particle count procedure of the Bureau of Reclamation known as a "Pebble Count" on a six inch by six inch section of crushed panels. All the pieces were very sharp and angular requiring great care during handling. The crushed particles attached to the panels were counted with an assignment of maximum dimension of 1/2 inches, as most of the particles were smaller than 1/2 inch minimum dimension. Some particles were elongated and the dimensions in longer axis were in some cases much larger than a few inches.

The residual particles were subject to the American Society for Testing and Materials (ASTM) method specified in ASTM D 422 without hydrometer analysis.

The results of the tests including pebble counts and gradation tests are attached in graphical form (Appendix B). Note that for Panels 4 and 5 in Appendix B, the size distribution stabilized at a value above 0 because the sample included a small quantity of soil mixed with the panel pieces. On average, approximately one-quarter of panel pieces were smaller than 1 cm and less than 5% of panel pieces were smaller than 0.1 mm. Since waste characterization leaching tests use sample sizes smaller than 1 cm, leachate potential derived from these tests represents a fraction of the total volume of landfilled CdTe PV panel waste.

Particle Size Distribution Results

		Leaching Tests			
		TCLP	STLC	EN 12457	Availability
Test method sample size (SS)		9.5 mm (3/8")	2 mm (#10)	4 mm (#4)	0.1 mm (#100)
Observed proportion of panel pieces finer than SS	Panel #1	12%	1%	6%	0
	Panel #2	27%	1%	6%	1%
	Panel #3	13%	0%	0%	0%
	Panel #4	40%	8%	19%	2%
	Panel #5	44%	10%	20%	3%

Test America Laboratory Analysis

After gradation testing was completed by HA a representative sample of the PV panels was selected from bag #2 (PV Panel 2) and bag #5 (PV Panel 5). This representative sample consisted of (by weight) approximately two thirds intact panel (crushed but in one piece) and one third loose fragments. In both cases, the glass-laminate-glass bond of individual broken panel pieces was maintained (i.e., individual panel pieces remained laminated). PV Panels 2 and 5 were chosen on the basis of their location in the test installation (in the center and perimeter, respectively). Once the samples were received by the Test America laboratory they were not altered in any way. The Test America laboratory report dated January 24, 2013 is attached as Appendix C. The results indicate that the crushed panels are non-hazardous.

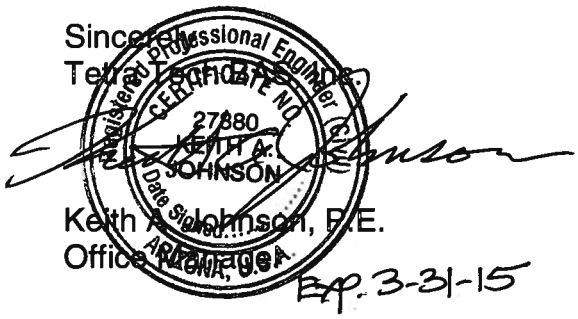
Test America Laboratory Results

	EPA HW #	TCLP Reg. Limit (mg/L)	PV Panel 2 TCLP (mg/L)	PV Panel 5 TCLP (mg/L)	PV Panel 2 STLC (mg/L)	PV Panel 5 STLC (mg/L)
Lead	D008	5.0	ND	ND	ND	ND
Cadmium	D006	1.0	0.19	ND	0.57	0.91

(TCLP Reg. Limit based on 40 CRF 261.24 Toxicity Characteristics, Table 1)

Tetra Tech BAS appreciates working with you on this challenging project. If you have any comments or questions please advise.

Sincerely,
Tetra Tech BAS Inc.



Keith A. Johnson, P.E.
Office Manager

Exp. 3-31-15

Attachments: Appendices A, B and C

Appendix A

Pictures

Appendix A
First Solar PV Panel Experiment

Appendix A
First Solar PV Panel Experiment

Appendix B

Gradations

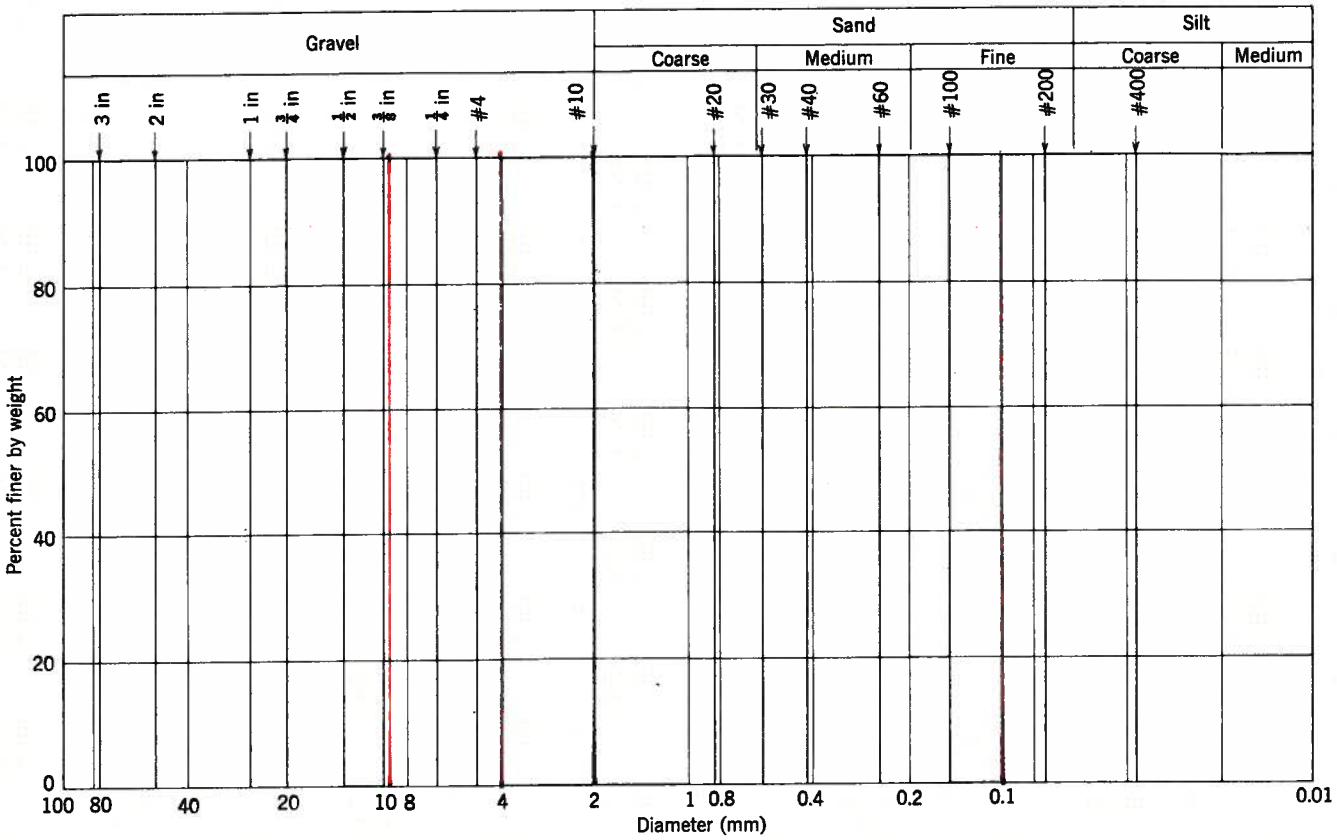


Fig. P3.10

3.8 Prove $Gw = Se$

3.9 A sample of parallel kaolinite particles (all have the size shown in Fig. 5.6) is saturated. The water content is 30%. What is the average particle spacing?

3.10 A sieve analysis on a soil yields the following results:

Sieve	3 in.	2 in.	1 in.	½ in.	#4	#10
Percentage passing	100	95	84	74	62	55

Sieve	#20	#40	#60	#100	#200
Percentage passing	44	32	24	16	9

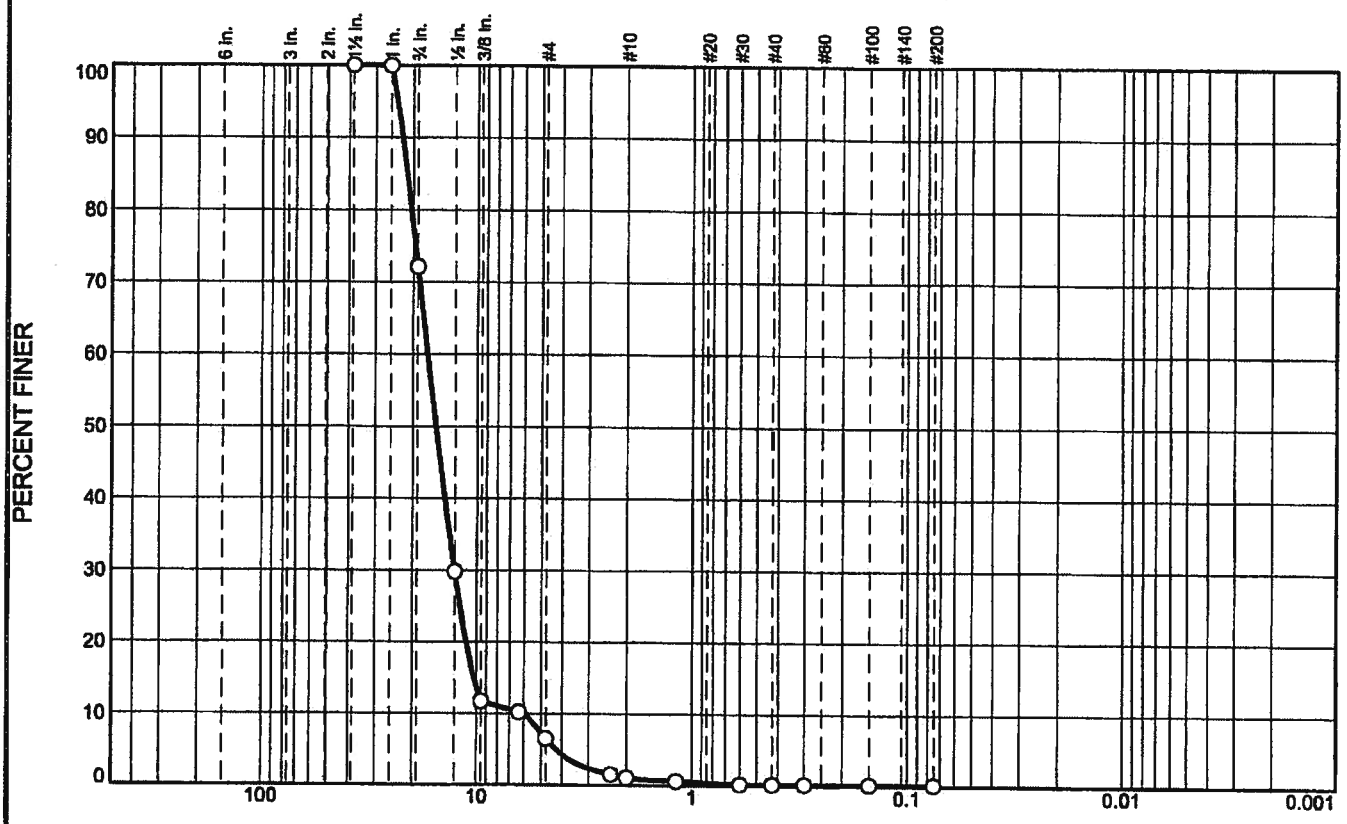
a. Plot the particle size distribution of this soil on Fig. P3.10 and classify the soil on the basis of the scale shown in the figure.

b. Comment on the suitability of this soil as drainage material behind a concrete retaining wall.

Hints. (*a*) Use Tables 3.5–3.7 to predict whether or not soil will be pervious, easy to work as construction material, etc. (*b*) A common guide for frost susceptibility is percentage finer than 0.02 mm must be less than 3% for material to be nonfrost susceptible.

3.11 Prove that the identity given by Eq. 3.1 is correct.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	28	66	5	1	0	0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2"	100		
1"	100		
3/4"	72		
1/2"	30		
3/8"	12		
1/4"	10		
#4	6		
#8	2		
#10	1		
#16	1		
#30	0		
#40	0		
#50	0		
#100	0		
#200	0.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.4028 D_{85}= 21.3420 D_{60}= 17.1149
D_{50}= 15.6170 D_{30}= 12.7270 D_{15}= 10.3065
D_{10}= 6.0642 C_u= 2.82 C_c= 1.56

Classification

USCS= GP AASHTO=

Remarks

Location: Bag #1
Sample Number: 12L0449

Date: 12-6-12

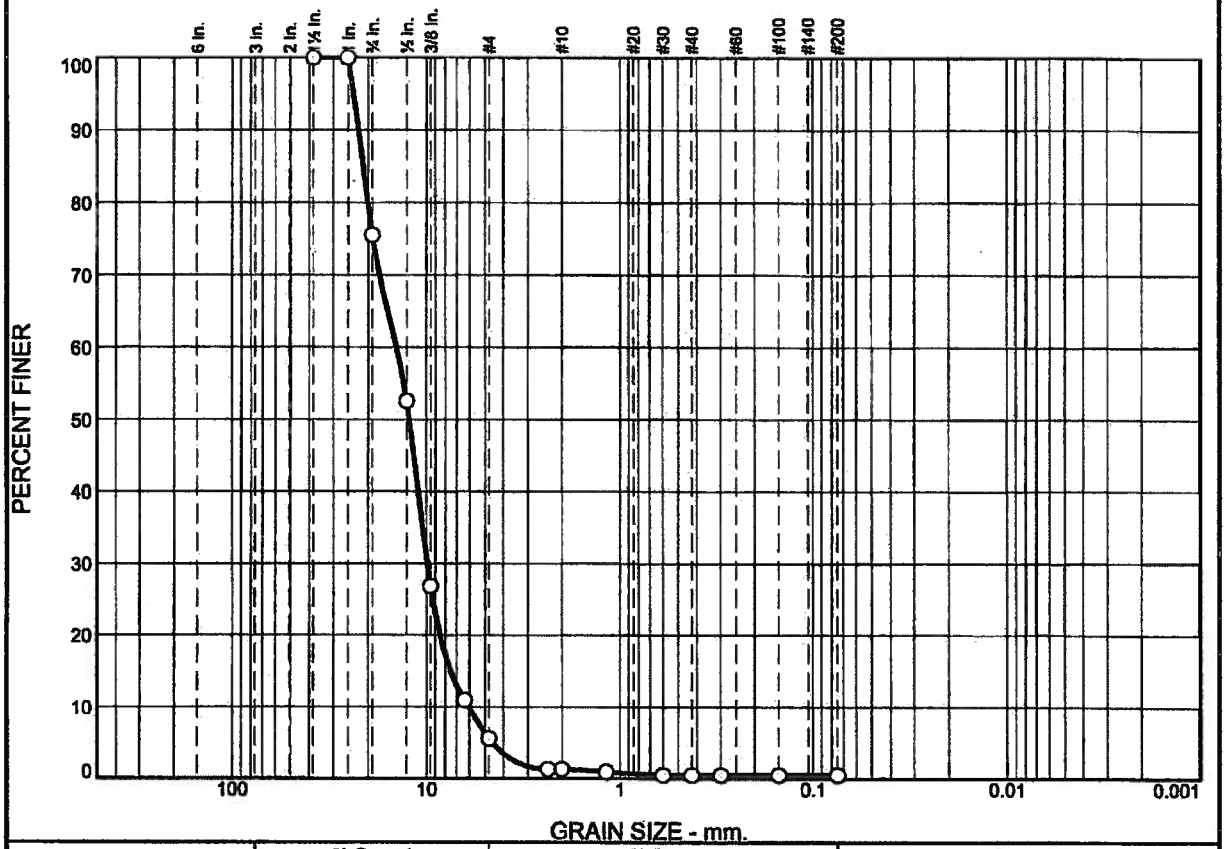
Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Tetra Tech BAS
Project: Solar Panel Crush Samples

Project No: 12084 **Lab Number** 12L0449

Tested By: AJ **Checked By:** TT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	24	70	5	0	0	1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2"	100		
1"	100		
3/4"	76		
1/2"	53		
3/8"	27		
1/4"	11		
#4	6		
#8	1		
#10	1		
#16	1		
#30	1		
#40	1		
#50	1		
#100	1		
#200	0.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.3628 D_{85}= 21.2035 D_{60}= 14.3232
D_{50}= 12.2929 D_{30}= 9.9004 D_{15}= 7.5300
D_{10}= 6.0524 C_u= 2.37 C_c= 1.13

Classification

USCS= GP AASHTO=

Remarks

Location: Bag #2
Sample Number: 12L0450

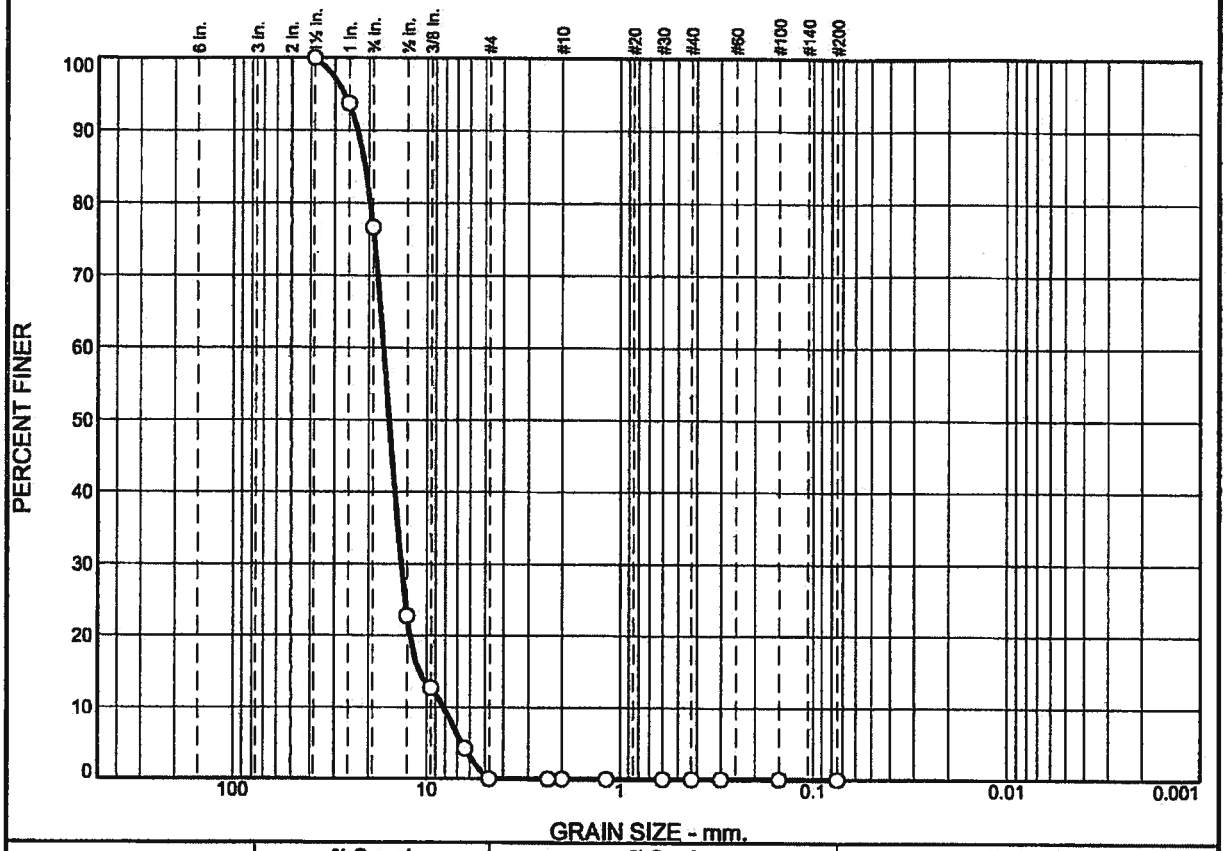
Date: 12-6-12

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Tetra Tech BAS
Project: Solar Panel Crush Samples
Project No: 12084 **Lab Number** 12L0450

Tested By: AJ **Checked By:** t

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	23	77	0	0	0	0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1-1/2"	100		
1"	94		
3/4"	77		
1/2"	23		
3/8"	13		
1/4"	4		
#4	0		
#8	0		
#10	0		
#16	0		
#30	0		
#40	0		
#50	0		
#100	0		
#200	0.0		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.8526 D_{85}= 20.9307 D_{60}= 16.7818
D_{50}= 15.7000 D_{30}= 13.6109 D_{15}= 10.9392
D_{10}= 8.1913 C_u= 2.05 C_c= 1.35

Classification

USCS= GP AASHTO=

Remarks

Location: Bag #3
Sample Number: 12L0451

Date: 12-6-12

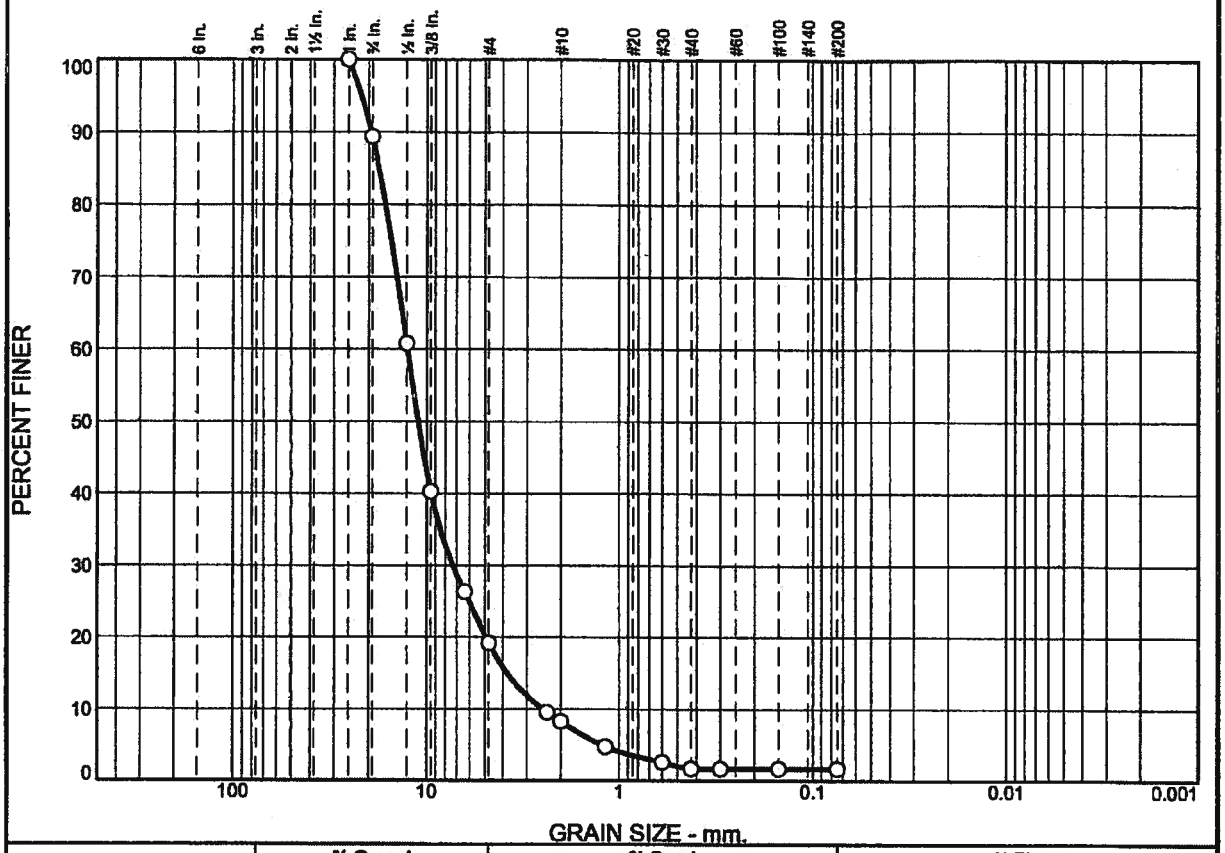
Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Tetra Tech BAS
Project: Solar Panel Crush Samples

Project No: 12084 **Lab Number** 12L0451

Tested By: AJ **Checked By:** TT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	11	70	11	6	0	2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	89		
1/2"	61		
3/8"	40		
1/4"	26		
#4	19		
#8	10		
#10	8		
#16	5		
#30	3		
#40	2		
#50	2		
#100	2		
#200	1.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 19.2928 D_{85}= 17.6295 D_{60}= 12.5750
D_{50}= 11.0502 D_{30}= 7.3258 D_{15}= 3.7950
D_{10}= 2.4776 C_u= 5.08 C_c= 1.72

Classification

USCS= GW AASHTO=

Remarks

Location: Bag #4
Sample Number: 12L0452

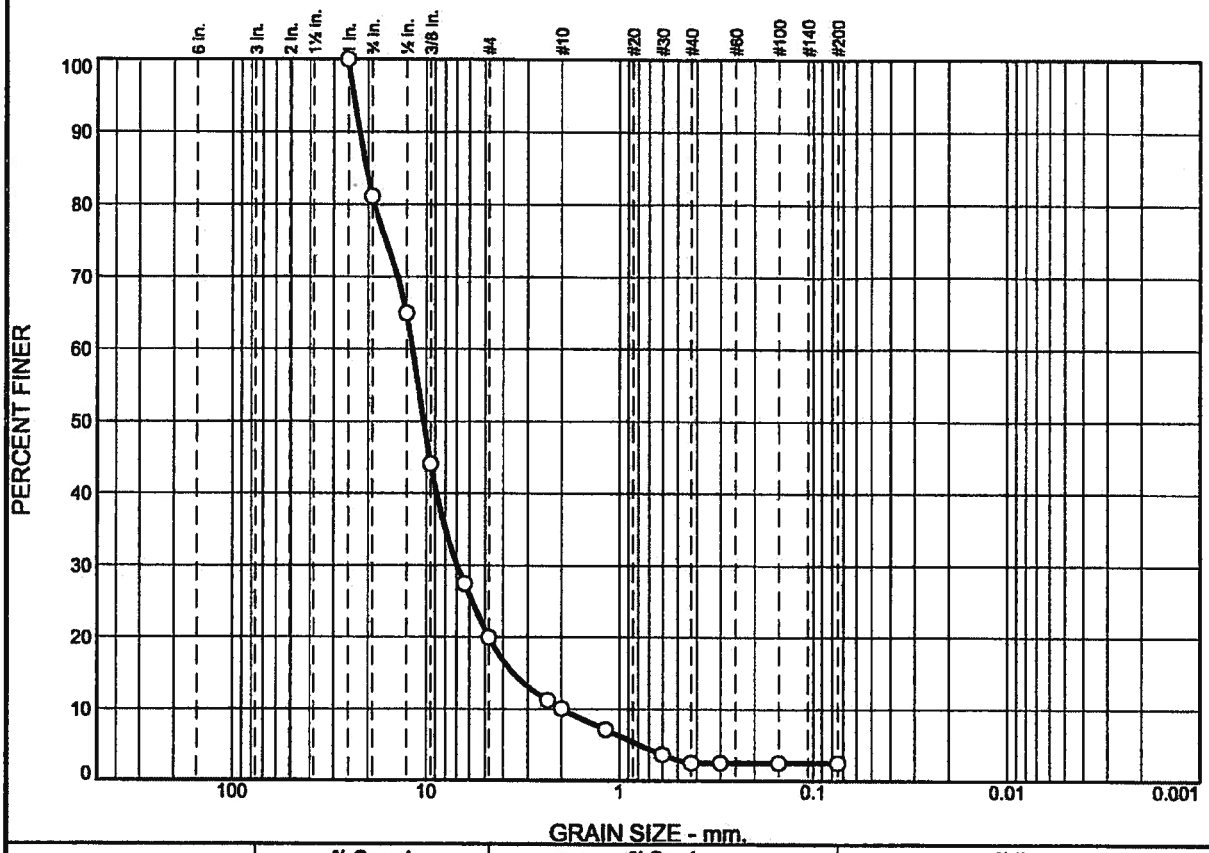
Date: 12-6-12

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Tetra Tech BAS
Project: Solar Panel Crush Samples
Project No: 12084 **Lab Number** 12L0452

Tested By: AJ **Checked By:** TT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	19	61	10	7	0	3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	81		
1/2"	65		
3/8"	44		
1/4"	27		
#4	20		
#8	11		
#10	10		
#16	7		
#30	4		
#40	3		
#50	3		
#100	3		
#200	2.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.1117 D_{85}= 20.4542 D_{60}= 11.7852
D_{50}= 10.3369 D_{30}= 6.9300 D_{15}= 3.5401
D_{10}= 1.9788 C_u= 5.96 C_c= 2.06

Classification

USCS= GW AASHTO=

Remarks

Location: Bag #5
Sample Number: 12L0453

Date: 12-6-12

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Tetra Tech BAS
Project: Solar Panel Crush Samples

Project No: 12084 **Lab Number** 12L0453

Tested By: AJ **Checked By:** TT

Appendix C

Test America Laboratory Results

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Phoenix
4625 East Cotton Center Blvd. Ste 189
Phoenix, AZ 85040
Tel: (602) 437-3340

TestAmerica Job ID: PWA0759
Client Project/Site: [none]
Client Project Description: Soils

For:
Tetra Tech BAS, Inc.
3822 E.University Dr., Ste. 2
Phoenix, AZ 85034

Attn: Keith Johnson

Carlene McCutcheon

Authorized for release by:
1/24/2013 3:42:17 PM

Carlene McCutcheon
Project Manager
carlene.mccutcheon@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Qualifiers

Metals

Qualifier	Qualifier Description
M1	Matrix spike recovery was high; the associated blank spike recovery was acceptable.
M2	Matrix spike recovery was low; the associated blank spike recovery was acceptable.
R1	RPD/RSD exceeded the method acceptance limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
DL, RA, RE, IN	Indicates a Dilution, Reanalysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
EDL	Estimated Detection Limit
EPA	United States Environmental Protection Agency
MDA	Minimum detectable activity
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Job ID: PWA0759

Laboratory: TestAmerica Irvine

Narrative

Job Narrative
440-35105-1

Comments
No additional comments.

Receipt
The samples were received on 1/15/2013 10:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 4.2° C.

Metals
Method(s) 6010B: The matrix spike / matrix spike duplicate (MS/MSD) precision for batch 79125 was outside control limits for Ba. Non-homogeneity of the sample matrix is suspected. The samples associated with this batch were non-detects for the affected analyte; therefore, the data have been reported.

Method(s) 6010B: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for Ba , Sb for batch 79125 were outside control limits. The associated laboratory control sample (LCS) recovery met acceptance criteria.

Method(s) 7471A: The matrix spike / matrix spike duplicate (MS/MSD) recoveries for mercury in batch 440-78983 were outside control limits. The associated laboratory control sample (LCS) recovery met acceptance criteria.

No other analytical or quality issues were noted.

Organic Prep
No analytical or quality issues were noted.

Detection Summary

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Client Sample ID: Crushed Solar Panel #2

Lab Sample ID: PWA0759-01

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cadmium	220		0.50		mg/Kg	5		6010B	Total/NA
Chromium	1.4		1.0		mg/Kg	5		6010B	Total/NA
Molybdenum	9.0		2.0		mg/Kg	5		6010B	Total/NA
Selenium	0.14		0.10		mg/L	1		6010B	TCLP
Cadmium	0.19		0.10		mg/L	1		6010B	TCLP
Cadmium	0.57		0.10		mg/L	20		6010B	STLC Citrate

Client Sample ID: Crushed Solar Panel #5

Lab Sample ID: PWA0759-02

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cadmium	800		0.50		mg/Kg	5		6010B	Total/NA
Cadmium	0.91		0.10		mg/L	20		6010B	STLC Citrate

This Detection Summary does not include radiochemical test results.

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Client Sample ID: Crushed Solar Panel #2
Date Collected: 12/06/12 08:00
Date Received: 01/14/13 08:57

Lab Sample ID: PWA0759-01
Matrix: Soil

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		10		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Arsenic	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Barium	ND		1.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Beryllium	ND		0.50		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Cadmium	**220**		0.50		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Chromium	**1.4**		1.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Cobalt	ND		1.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Copper	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Lead	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Molybdenum	**9.0**		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Nickel	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Selenium	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Thallium	ND		10		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Vanadium	ND		1.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Zinc	ND		5.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5
Silver	ND		1.0		mg/Kg		01/16/13 08:42	01/16/13 14:16	5

Method: 6010B - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	**0.14**		0.10		mg/L		01/16/13 13:07	01/17/13 12:39	1
Lead	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:39	1
Chromium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:39	1
Cadmium	**0.19**		0.10		mg/L		01/16/13 13:07	01/17/13 12:39	1
Barium	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:39	1
Arsenic	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:39	1
Silver	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:39	1

Method: 6010B - Metals (ICP) - STLC Citrate

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		0.20		mg/L			01/22/13 11:29	20
Arsenic	ND		0.20		mg/L			01/22/13 11:29	20
Barium	ND		0.20		mg/L			01/22/13 11:29	20
Beryllium	ND		0.080		mg/L			01/22/13 11:29	20
Cadmium	**0.57**		0.10		mg/L			01/22/13 11:29	20
Chromium	ND		0.10		mg/L			01/22/13 11:29	20
Cobalt	ND		0.20		mg/L			01/22/13 11:29	20
Copper	ND		0.20		mg/L			01/22/13 11:29	20
Lead	ND		0.10		mg/L			01/22/13 11:29	20
Molybdenum	ND		0.40		mg/L			01/22/13 11:29	20
Nickel	ND		0.20		mg/L			01/22/13 11:29	20
Selenium	ND		0.20		mg/L			01/22/13 11:29	20
Thallium	ND		0.20		mg/L			01/22/13 11:29	20
Vanadium	ND		0.20		mg/L			01/22/13 11:29	20
Zinc	ND		0.40		mg/L			01/22/13 11:29	20
Silver	ND		0.20		mg/L			01/22/13 11:29	20

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/16/13 14:55	01/16/13 17:51	1

Client Sample ID: Crushed Solar Panel #2

Lab Sample ID: PWA0759-01

Date Collected: 12/06/12 08:00
Matrix: Soil
Date Received: 01/14/13 08:57

Method: 7470A - Mercury (CVAA) - STLC Citrate

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/18/13 10:20	01/18/13 16:05	1

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.020		mg/Kg		01/16/13 10:25	01/16/13 12:03	1

Client Sample ID: Crushed Solar Panel #5

Lab Sample ID: PWA0759-02

Date Collected: 12/06/12 08:00
Matrix: Soil
Date Received: 01/14/13 08:57

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		9.9		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Arsenic	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Barium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Beryllium	ND		0.50		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Cadmium	800		0.50		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Chromium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Cobalt	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Copper	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Lead	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Molybdenum	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Nickel	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Selenium	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Thallium	ND		9.9		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Vanadium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Zinc	ND		5.0		mg/Kg		01/16/13 08:42	01/16/13 14:19	5
Silver	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 14:19	5

Method: 6010B - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:44	1
Lead	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:44	1
Chromium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:44	1
Cadmium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:44	1
Barium	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:44	1
Arsenic	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:44	1
Silver	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:44	1

Method: 6010B - Metals (ICP) - STLC Citrate

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		0.20		mg/L			01/22/13 11:32	20
Arsenic	ND		0.20		mg/L			01/22/13 11:32	20
Barium	ND		0.20		mg/L			01/22/13 11:32	20
Beryllium	ND		0.080		mg/L			01/22/13 11:32	20
Cadmium	0.91		0.10		mg/L			01/22/13 11:32	20
Chromium	ND		0.10		mg/L			01/22/13 11:32	20
Cobalt	ND		0.20		mg/L			01/22/13 11:32	20
Copper	ND		0.20		mg/L			01/22/13 11:32	20
Lead	ND		0.10		mg/L			01/22/13 11:32	20

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Client Sample ID: Crushed Solar Panel #5
Date Collected: 12/06/12 08:00
Date Received: 01/14/13 08:57

Lab Sample ID: PWA0759-02
Matrix: Soil

Method: 6010B - Metals (ICP) - STLC Citrate (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Molybdenum	ND		0.40		mg/L			01/22/13 11:32	20
Nickel	ND		0.20		mg/L			01/22/13 11:32	20
Selenium	ND		0.20		mg/L			01/22/13 11:32	20
Thallium	ND		0.20		mg/L			01/22/13 11:32	20
Vanadium	ND		0.20		mg/L			01/22/13 11:32	20
Zinc	ND		0.40		mg/L			01/22/13 11:32	20
Silver	ND		0.20		mg/L			01/22/13 11:32	20

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/16/13 14:55	01/16/13 17:59	1

Method: 7470A - Mercury (CVAA) - STLC Citrate

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/18/13 10:20	01/18/13 16:13	1

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.020		mg/Kg		01/16/13 10:25	01/16/13 12:06	1

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 440-79125/1-A ^5
Matrix: Solid
Analysis Batch: 79264

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 79125

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		9.9		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Beryllium	ND		0.50		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Barium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Cadmium	ND		0.50		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Arsenic	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Chromium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Cobalt	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Copper	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Lead	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Molybdenum	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Nickel	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Selenium	ND		2.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Thallium	ND		9.9		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Vanadium	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Zinc	ND		5.0		mg/Kg		01/16/13 08:42	01/16/13 13:41	5
Silver	ND		0.99		mg/Kg		01/16/13 08:42	01/16/13 13:41	5

Lab Sample ID: LCS 440-79125/2-A ^5
Matrix: Solid
Analysis Batch: 79264

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 79125

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	49.8	45.4		mg/Kg		91	80 - 120
Beryllium	49.8	46.8		mg/Kg		94	80 - 120
Barium	49.8	48.0		mg/Kg		97	80 - 120
Cadmium	49.8	46.3		mg/Kg		93	80 - 120
Arsenic	49.8	45.7		mg/Kg		92	80 - 120
Chromium	49.8	45.6		mg/Kg		92	80 - 120
Cobalt	49.8	46.3		mg/Kg		93	80 - 120
Copper	49.8	46.0		mg/Kg		93	80 - 120
Lead	49.8	45.7		mg/Kg		92	80 - 120
Molybdenum	49.8	44.8		mg/Kg		90	80 - 120
Nickel	49.8	47.3		mg/Kg		95	80 - 120
Selenium	49.8	40.9		mg/Kg		82	80 - 120
Thallium	49.8	47.4		mg/Kg		95	80 - 120
Vanadium	49.8	45.8		mg/Kg		92	80 - 120
Zinc	49.8	44.8		mg/Kg		90	80 - 120
Silver	24.9	23.1		mg/Kg		93	80 - 120

Lab Sample ID: 440-35153-A-1-G MS ^5
Matrix: Solid
Analysis Batch: 79264

Client Sample ID: Matrix Spike
Prep Type: Total/NA
Prep Batch: 79125

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	ND	M2	49.5	17.6	M2	mg/Kg		36	75 - 125
Beryllium	0.71		49.5	47.8		mg/Kg		95	75 - 125
Barium	110	M1 R1	49.5	165		mg/Kg		119	75 - 125
Cadmium	ND		49.5	44.2		mg/Kg		89	75 - 125

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 440-35153-A-1-G MS ^5
Matrix: Solid
Analysis Batch: 79264

Client Sample ID: Matrix Spike
Prep Type: Total/NA
Prep Batch: 79125

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	5.2		49.5	49.9		mg/Kg		90	75 - 125
Chromium	26		49.5	76.0		mg/Kg		100	75 - 125
Cobalt	9.0		49.5	54.3		mg/Kg		91	75 - 125
Copper	24		49.5	70.0		mg/Kg		94	75 - 125
Lead	7.1		49.5	51.5		mg/Kg		90	75 - 125
Molybdenum	ND		49.5	44.0		mg/Kg		86	75 - 125
Nickel	19		49.5	65.7		mg/Kg		94	75 - 125
Selenium	ND		49.5	41.8		mg/Kg		84	75 - 125
Thallium	ND		49.5	49.5		mg/Kg		91	75 - 125
Vanadium	47		49.5	102		mg/Kg		110	75 - 125
Zinc	57		49.5	103		mg/Kg		93	75 - 125
Silver	ND		24.8	18.8		mg/Kg		76	75 - 125

Lab Sample ID: 440-35153-A-1-H MSD ^5
Matrix: Solid
Analysis Batch: 79264

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA
Prep Batch: 79125

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	ND	M2	50.0	16.4	M2	mg/Kg		33	75 - 125	7	20
Beryllium	0.71		50.0	48.6		mg/Kg		96	75 - 125	2	20
Barium	110	M1 R1	50.0	237	M1 R1	mg/Kg		261	75 - 125	36	20
Cadmium	ND		50.0	45.4		mg/Kg		91	75 - 125	3	20
Arsenic	5.2		50.0	50.5		mg/Kg		91	75 - 125	1	20
Chromium	26		50.0	77.5		mg/Kg		102	75 - 125	2	20
Cobalt	9.0		50.0	57.1		mg/Kg		96	75 - 125	5	20
Copper	24		50.0	72.5		mg/Kg		98	75 - 125	4	20
Lead	7.1		50.0	52.5		mg/Kg		91	75 - 125	2	20
Molybdenum	ND		50.0	45.0		mg/Kg		87	75 - 125	2	20
Nickel	19		50.0	67.3		mg/Kg		96	75 - 125	2	20
Selenium	ND		50.0	39.6		mg/Kg		79	75 - 125	5	20
Thallium	ND		50.0	49.9		mg/Kg		91	75 - 125	1	20
Vanadium	47		50.0	109		mg/Kg		124	75 - 125	7	20
Zinc	57		50.0	109		mg/Kg		104	75 - 125	6	20
Silver	ND		25.0	19.0		mg/Kg		76	75 - 125	1	20

Lab Sample ID: MB 440-79060/1-B
Matrix: Solid
Analysis Batch: 79525

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 79214

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Barium	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:35	1
Cadmium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:35	1
Arsenic	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:35	1
Chromium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:35	1
Lead	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:35	1
Selenium	ND		0.10		mg/L		01/16/13 13:07	01/17/13 12:35	1
Silver	ND		0.20		mg/L		01/16/13 13:07	01/17/13 12:35	1

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: LCS 440-79060/2-B
Matrix: Solid
Analysis Batch: 79525

Client Sample ID: Lab Control Sample
Prep Type: TCLP
Prep Batch: 79214

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Barium	2.00	2.04		mg/L		102	80 - 120
Cadmium	2.00	2.11		mg/L		105	80 - 120
Arsenic	2.00	2.13		mg/L		106	80 - 120
Chromium	2.00	2.05		mg/L		102	80 - 120
Lead	2.00	2.08		mg/L		104	80 - 120
Selenium	2.00	2.08		mg/L		104	80 - 120
Silver	1.00	0.896		mg/L		90	80 - 120

Lab Sample ID: 440-35105-1 MS
Matrix: Solid
Analysis Batch: 79525

Client Sample ID: PWA0759-01
Prep Type: TCLP
Prep Batch: 79214

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Barium	ND		2.00	2.06		mg/L		95	75 - 125
Cadmium	0.19		2.00	2.28		mg/L		105	75 - 125
Arsenic	ND		2.00	2.08		mg/L		104	75 - 125
Chromium	ND		2.00	2.03		mg/L		101	75 - 125
Lead	ND		2.00	2.06		mg/L		103	75 - 125
Selenium	0.14		2.00	1.97		mg/L		92	75 - 125
Silver	ND		1.00	0.896		mg/L		90	75 - 125

Lab Sample ID: MB 440-79063/1-A ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Method Blank
Prep Type: STLC Citrate

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		0.20		mg/L			01/22/13 12:36	20
Beryllium	ND		0.080		mg/L			01/22/13 12:36	20
Barium	ND		0.20		mg/L			01/22/13 12:36	20
Cadmium	ND		0.10		mg/L			01/22/13 12:36	20
Arsenic	ND		0.20		mg/L			01/22/13 12:36	20
Chromium	ND		0.10		mg/L			01/22/13 12:36	20
Cobalt	ND		0.20		mg/L			01/22/13 12:36	20
Copper	ND		0.20		mg/L			01/22/13 12:36	20
Lead	ND		0.10		mg/L			01/22/13 12:36	20
Molybdenum	ND		0.40		mg/L			01/22/13 12:36	20
Nickel	ND		0.20		mg/L			01/22/13 12:36	20
Selenium	ND		0.20		mg/L			01/22/13 12:36	20
Thallium	ND		0.20		mg/L			01/22/13 12:36	20
Vanadium	ND		0.20		mg/L			01/22/13 12:36	20
Zinc	ND		0.40		mg/L			01/22/13 12:36	20
Silver	ND		0.20		mg/L			01/22/13 12:36	20

Lab Sample ID: LCS 440-79063/2-A ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Lab Control Sample
Prep Type: STLC Citrate

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	20.0	19.6		mg/L		98	80 - 120

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: LCS 440-79063/2-A ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Lab Control Sample
Prep Type: STLC Citrate

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Beryllium	20.0	19.4		mg/L		97	80 - 120
Barium	20.0	19.2		mg/L		96	80 - 120
Cadmium	20.0	18.8		mg/L		94	80 - 120
Arsenic	20.0	19.6		mg/L		98	80 - 120
Chromium	20.0	19.1		mg/L		95	80 - 120
Cobalt	20.0	19.0		mg/L		95	80 - 120
Copper	20.0	20.0		mg/L		100	80 - 120
Lead	20.0	18.2		mg/L		91	80 - 120
Molybdenum	20.0	20.5		mg/L		103	80 - 120
Nickel	20.0	19.1		mg/L		95	80 - 120
Selenium	20.0	18.4		mg/L		92	80 - 120
Thallium	20.0	17.4		mg/L		87	80 - 120
Vanadium	20.0	19.9		mg/L		99	80 - 120
Zinc	20.0	19.0		mg/L		95	80 - 120
Silver	10.0	9.27		mg/L		93	80 - 120

Lab Sample ID: 440-34737-A-1-J MS ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Matrix Spike
Prep Type: STLC Citrate

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.32		20.0	20.2		mg/L		99	75 - 125
Beryllium	ND		20.0	19.7		mg/L		99	75 - 125
Barium	3.3		20.0	21.7		mg/L		92	75 - 125
Cadmium	ND		20.0	18.2		mg/L		91	75 - 125
Arsenic	0.26		20.0	20.6		mg/L		101	75 - 125
Chromium	0.44		20.0	19.2		mg/L		94	75 - 125
Cobalt	0.22		20.0	18.7		mg/L		92	75 - 125
Copper	ND		20.0	19.6		mg/L		98	75 - 125
Lead	0.46		20.0	18.5		mg/L		90	75 - 125
Molybdenum	ND		20.0	20.8		mg/L		103	75 - 125
Nickel	0.26		20.0	17.6		mg/L		87	75 - 125
Selenium	0.22		20.0	18.7		mg/L		92	75 - 125
Thallium	ND		20.0	17.4		mg/L		87	75 - 125
Vanadium	0.46		20.0	20.2		mg/L		99	75 - 125
Zinc	15		20.0	33.5		mg/L		92	75 - 125
Silver	ND		10.0	9.10		mg/L		91	75 - 125

Lab Sample ID: 440-34737-A-1-J MSD ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Matrix Spike Duplicate
Prep Type: STLC Citrate

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	0.32		20.0	19.1		mg/L		94	75 - 125	6	20
Beryllium	ND		20.0	18.7		mg/L		93	75 - 125	5	20
Barium	3.3		20.0	20.7		mg/L		87	75 - 125	4	20
Cadmium	ND		20.0	17.5		mg/L		88	75 - 125	4	20
Arsenic	0.26		20.0	19.4		mg/L		96	75 - 125	6	20
Chromium	0.44		20.0	18.3		mg/L		90	75 - 125	4	20

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 440-34737-A-1-J MSD ^20
Matrix: Solid
Analysis Batch: 80253

Client Sample ID: Matrix Spike Duplicate
Prep Type: STLC Citrate

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Cobalt	0.22		20.0	17.9		mg/L		88	75 - 125	4	20
Copper	ND		20.0	18.7		mg/L		93	75 - 125	5	20
Lead	0.46		20.0	17.5		mg/L		85	75 - 125	5	20
Molybdenum	ND		20.0	19.6		mg/L		98	75 - 125	6	20
Nickel	0.26		20.0	17.0		mg/L		83	75 - 125	4	20
Selenium	0.22		20.0	17.8		mg/L		88	75 - 125	5	20
Thallium	ND		20.0	16.5		mg/L		82	75 - 125	6	20
Vanadium	0.46		20.0	19.4		mg/L		95	75 - 125	4	20
Zinc	15		20.0	32.0		mg/L		84	75 - 125	5	20
Silver	ND		10.0	8.72		mg/L		87	75 - 125	4	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 440-79060/1-C
Matrix: Solid
Analysis Batch: 79334

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 79260

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/16/13 14:55	01/16/13 17:46	1

Lab Sample ID: LCS 440-79060/2-C
Matrix: Solid
Analysis Batch: 79334

Client Sample ID: Lab Control Sample
Prep Type: TCLP
Prep Batch: 79260

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.0800	0.0830		mg/L		104	80 - 120

Lab Sample ID: 440-35105-1 MS
Matrix: Solid
Analysis Batch: 79334

Client Sample ID: PWA0759-01
Prep Type: TCLP
Prep Batch: 79260

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	ND		0.0800	0.0826		mg/L		103	70 - 130

Lab Sample ID: 440-35105-1 MSD
Matrix: Solid
Analysis Batch: 79334

Client Sample ID: PWA0759-01
Prep Type: TCLP
Prep Batch: 79260

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	ND		0.0800	0.0829		mg/L		104	70 - 130	0	20

Lab Sample ID: MB 440-79063/1-B
Matrix: Solid
Analysis Batch: 79817

Client Sample ID: Method Blank
Prep Type: STLC Citrate
Prep Batch: 79666

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.0020		mg/L		01/18/13 10:20	01/18/13 16:00	1

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: LCS 440-79063/2-B
Matrix: Solid
Analysis Batch: 79817

Client Sample ID: Lab Control Sample
Prep Type: STLC Citrate
Prep Batch: 79666

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.0800	0.0807		mg/L		101	80 - 120

Lab Sample ID: 440-35105-1 MS
Matrix: Solid
Analysis Batch: 79817

Client Sample ID: PWA0759-01
Prep Type: STLC Citrate
Prep Batch: 79666

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	ND		0.0800	0.0794		mg/L		99	70 - 130

Lab Sample ID: 440-35105-1 MSD
Matrix: Solid
Analysis Batch: 79817

Client Sample ID: PWA0759-01
Prep Type: STLC Citrate
Prep Batch: 79666

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	ND		0.0800	0.0801		mg/L		100	70 - 130	1	20

Method: 7471A - Mercury (CVAA)

Lab Sample ID: MB 440-78983/1-A
Matrix: Solid
Analysis Batch: 79203

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 78983

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.020		mg/Kg		01/16/13 10:25	01/16/13 11:48	1

Lab Sample ID: LCS 440-78983/2-A
Matrix: Solid
Analysis Batch: 79203

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 78983

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.800	0.760		mg/Kg		95	80 - 120

Lab Sample ID: 440-34927-A-7-M MS
Matrix: Solid
Analysis Batch: 79203

Client Sample ID: Matrix Spike
Prep Type: Total/NA
Prep Batch: 78983

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.054	M1	0.816	1.14	M1	mg/Kg		133	70 - 130

Lab Sample ID: 440-34927-A-7-N MSD
Matrix: Solid
Analysis Batch: 79203

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA
Prep Batch: 78983

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	0.054	M1	0.800	1.09		mg/Kg		129	70 - 130	5	20

QC Association Summary

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Metals

Prep Batch: 78983

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-34927-A-7-M MS	Matrix Spike	Total/NA	Solid	7471A	
440-34927-A-7-N MSD	Matrix Spike Duplicate	Total/NA	Solid	7471A	
LCS 440-78983/2-A	Lab Control Sample	Total/NA	Solid	7471A	
MB 440-78983/1-A	Method Blank	Total/NA	Solid	7471A	
PWA0759-01	Crushed Solar Panel #2	Total/NA	Soil	7471A	
PWA0759-02	Crushed Solar Panel #5	Total/NA	Soil	7471A	

Leach Batch: 79060

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	TCLP	Solid	1311	
440-35105-1 MSD	PWA0759-01	TCLP	Solid	1311	
LCS 440-79060/2-B	Lab Control Sample	TCLP	Solid	1311	
LCS 440-79060/2-C	Lab Control Sample	TCLP	Solid	1311	
MB 440-79060/1-B	Method Blank	TCLP	Solid	1311	
MB 440-79060/1-C	Method Blank	TCLP	Solid	1311	
PWA0759-01	Crushed Solar Panel #2	TCLP	Soil	1311	
PWA0759-02	Crushed Solar Panel #5	TCLP	Soil	1311	

Leach Batch: 79063

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-34737-A-1-J MS ^20	Matrix Spike	STLC Citrate	Solid	CA WET Citrate	
440-34737-A-1-J MSD ^20	Matrix Spike Duplicate	STLC Citrate	Solid	CA WET Citrate	
440-35105-1 MS	PWA0759-01	STLC Citrate	Solid	CA WET Citrate	
440-35105-1 MSD	PWA0759-01	STLC Citrate	Solid	CA WET Citrate	
LCS 440-79063/2-A ^20	Lab Control Sample	STLC Citrate	Solid	CA WET Citrate	
LCS 440-79063/2-B	Lab Control Sample	STLC Citrate	Solid	CA WET Citrate	
MB 440-79063/1-A ^20	Method Blank	STLC Citrate	Solid	CA WET Citrate	
MB 440-79063/1-B	Method Blank	STLC Citrate	Solid	CA WET Citrate	
PWA0759-01	Crushed Solar Panel #2	STLC Citrate	Soil	CA WET Citrate	
PWA0759-02	Crushed Solar Panel #5	STLC Citrate	Soil	CA WET Citrate	

Prep Batch: 79125

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35153-A-1-G MS ^5	Matrix Spike	Total/NA	Solid	3050B	
440-35153-A-1-H MSD ^5	Matrix Spike Duplicate	Total/NA	Solid	3050B	
LCS 440-79125/2-A ^5	Lab Control Sample	Total/NA	Solid	3050B	
MB 440-79125/1-A ^5	Method Blank	Total/NA	Solid	3050B	
PWA0759-01	Crushed Solar Panel #2	Total/NA	Soil	3050B	
PWA0759-02	Crushed Solar Panel #5	Total/NA	Soil	3050B	

Analysis Batch: 79203

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-34927-A-7-M MS	Matrix Spike	Total/NA	Solid	7471A	78983
440-34927-A-7-N MSD	Matrix Spike Duplicate	Total/NA	Solid	7471A	78983
LCS 440-78983/2-A	Lab Control Sample	Total/NA	Solid	7471A	78983
MB 440-78983/1-A	Method Blank	Total/NA	Solid	7471A	78983
PWA0759-01	Crushed Solar Panel #2	Total/NA	Soil	7471A	78983
PWA0759-02	Crushed Solar Panel #5	Total/NA	Soil	7471A	78983

Metals (Continued)

Prep Batch: 79214

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	TCLP	Solid	3010A	79060
LCS 440-79060/2-B	Lab Control Sample	TCLP	Solid	3010A	79060
MB 440-79060/1-B	Method Blank	TCLP	Solid	3010A	79060
PWA0759-01	Crushed Solar Panel #2	TCLP	Soil	3010A	79060
PWA0759-02	Crushed Solar Panel #5	TCLP	Soil	3010A	79060

Prep Batch: 79260

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	TCLP	Solid	7470A	79060
440-35105-1 MSD	PWA0759-01	TCLP	Solid	7470A	79060
LCS 440-79060/2-C	Lab Control Sample	TCLP	Solid	7470A	79060
MB 440-79060/1-C	Method Blank	TCLP	Solid	7470A	79060
PWA0759-01	Crushed Solar Panel #2	TCLP	Soil	7470A	79060
PWA0759-02	Crushed Solar Panel #5	TCLP	Soil	7470A	79060

Analysis Batch: 79264

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35153-A-1-G MS ^5	Matrix Spike	Total/NA	Solid	6010B	79125
440-35153-A-1-H MSD ^5	Matrix Spike Duplicate	Total/NA	Solid	6010B	79125
LCS 440-79125/2-A ^5	Lab Control Sample	Total/NA	Solid	6010B	79125
MB 440-79125/1-A ^5	Method Blank	Total/NA	Solid	6010B	79125
PWA0759-01	Crushed Solar Panel #2	Total/NA	Soil	6010B	79125
PWA0759-02	Crushed Solar Panel #5	Total/NA	Soil	6010B	79125

Analysis Batch: 79334

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	TCLP	Solid	7470A	79260
440-35105-1 MSD	PWA0759-01	TCLP	Solid	7470A	79260
LCS 440-79060/2-C	Lab Control Sample	TCLP	Solid	7470A	79260
MB 440-79060/1-C	Method Blank	TCLP	Solid	7470A	79260
PWA0759-01	Crushed Solar Panel #2	TCLP	Soil	7470A	79260
PWA0759-02	Crushed Solar Panel #5	TCLP	Soil	7470A	79260

Analysis Batch: 79525

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	TCLP	Solid	6010B	79214
LCS 440-79060/2-B	Lab Control Sample	TCLP	Solid	6010B	79214
MB 440-79060/1-B	Method Blank	TCLP	Solid	6010B	79214
PWA0759-01	Crushed Solar Panel #2	TCLP	Soil	6010B	79214
PWA0759-02	Crushed Solar Panel #5	TCLP	Soil	6010B	79214

Prep Batch: 79666

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	STLC Citrate	Solid	7470A	79063
440-35105-1 MSD	PWA0759-01	STLC Citrate	Solid	7470A	79063
LCS 440-79063/2-B	Lab Control Sample	STLC Citrate	Solid	7470A	79063
MB 440-79063/1-B	Method Blank	STLC Citrate	Solid	7470A	79063
PWA0759-01	Crushed Solar Panel #2	STLC Citrate	Soil	7470A	79063
PWA0759-02	Crushed Solar Panel #5	STLC Citrate	Soil	7470A	79063

Metals (Continued)

Analysis Batch: 79817

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-35105-1 MS	PWA0759-01	STLC Citrate	Solid	7470A	79666
440-35105-1 MSD	PWA0759-01	STLC Citrate	Solid	7470A	79666
LCS 440-79063/2-B	Lab Control Sample	STLC Citrate	Solid	7470A	79666
MB 440-79063/1-B	Method Blank	STLC Citrate	Solid	7470A	79666
PWA0759-01	Crushed Solar Panel #2	STLC Citrate	Soil	7470A	79666
PWA0759-02	Crushed Solar Panel #5	STLC Citrate	Soil	7470A	79666

Analysis Batch: 80192

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
PWA0759-01	Crushed Solar Panel #2	STLC Citrate	Soil	6010B	79063
PWA0759-02	Crushed Solar Panel #5	STLC Citrate	Soil	6010B	79063

Analysis Batch: 80253

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-34737-A-1-J MS ^20	Matrix Spike	STLC Citrate	Solid	6010B	79063
440-34737-A-1-J MSD ^20	Matrix Spike Duplicate	STLC Citrate	Solid	6010B	79063
LCS 440-79063/2-A ^20	Lab Control Sample	STLC Citrate	Solid	6010B	79063
MB 440-79063/1-A ^20	Method Blank	STLC Citrate	Solid	6010B	79063

Lab Chronicle

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Client Sample ID: Crushed Solar Panel #2

Lab Sample ID: PWA0759-01

Date Collected: 12/06/12 08:00
Matrix: Soil
Date Received: 01/14/13 08:57

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	7471A			78983	01/16/13 10:25	MM	TAL IRV
Total/NA	Analysis	7471A		1	79203	01/16/13 12:03	DB	TAL IRV
Total/NA	Prep	3050B			79125	01/16/13 08:42	DT	TAL IRV
Total/NA	Analysis	6010B		5	79264	01/16/13 14:16	EN	TAL IRV
TCLP	Leach	1311			79060	01/15/13 19:29	SN	TAL IRV
TCLP	Prep	7470A			79260	01/16/13 14:55	MM	TAL IRV
TCLP	Analysis	7470A		1	79334	01/16/13 17:51	DB	TAL IRV
TCLP	Prep	3010A			79214	01/16/13 13:07	SN	TAL IRV
TCLP	Analysis	6010B		1	79525	01/17/13 12:39	DT	TAL IRV
STLC Citrate	Leach	CA WET Citrate			79063	01/15/13 19:41	SN	TAL IRV
STLC Citrate	Prep	7470A			79666	01/18/13 10:20	MM	TAL IRV
STLC Citrate	Analysis	7470A		1	79817	01/18/13 16:05	DB	TAL IRV
STLC Citrate	Analysis	6010B		20	80192	01/22/13 11:29	EN	TAL IRV

Client Sample ID: Crushed Solar Panel #5

Lab Sample ID: PWA0759-02

Date Collected: 12/06/12 08:00
Matrix: Soil
Date Received: 01/14/13 08:57

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	7471A			78983	01/16/13 10:25	MM	TAL IRV
Total/NA	Analysis	7471A		1	79203	01/16/13 12:06	DB	TAL IRV
Total/NA	Prep	3050B			79125	01/16/13 08:42	DT	TAL IRV
Total/NA	Analysis	6010B		5	79264	01/16/13 14:19	EN	TAL IRV
TCLP	Leach	1311			79060	01/15/13 19:29	SN	TAL IRV
TCLP	Prep	7470A			79260	01/16/13 14:55	MM	TAL IRV
TCLP	Analysis	7470A		1	79334	01/16/13 17:59	DB	TAL IRV
TCLP	Prep	3010A			79214	01/16/13 13:07	SN	TAL IRV
TCLP	Analysis	6010B		1	79525	01/17/13 12:44	DT	TAL IRV
STLC Citrate	Leach	CA WET Citrate			79063	01/15/13 19:41	SN	TAL IRV
STLC Citrate	Prep	7470A			79666	01/18/13 10:20	MM	TAL IRV
STLC Citrate	Analysis	7470A		1	79817	01/18/13 16:13	DB	TAL IRV
STLC Citrate	Analysis	6010B		20	80192	01/22/13 11:32	EN	TAL IRV

Laboratory References:

TAL IRV = TestAmerica Irvine, 17461 Derian Ave, Suite 100, Irvine, CA 92614-5817, TEL (949)261-1022

Certification Summary

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Laboratory: TestAmerica Phoenix

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
AIHA - LAP	IHLAP		154268	07-01-13
Arizona	State Program	9	AZ0728	06-09-13
California	NELAP	9	01109CA	11-30-13
Nevada	State Program	9	AZ01030	07-31-13
New York	NELAP	2	11898	04-01-13
Oregon	NELAP	10	AZ100001	03-08-13
USDA	Federal		P330-09-00024	09-14-13

Laboratory: TestAmerica Irvine

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska	State Program	10	CA01531	06-30-13
Arizona	State Program	9	AZ0671	10-13-13
California	LA Cty Sanitation Districts	9	10256	01-31-14
California	NELAP	9	1108CA	01-31-13
California	State Program	9	2706	06-30-14
Guam	State Program	9	Cert. No. 12.002r	01-23-13
Hawaii	State Program	9	N/A	01-31-13
Nevada	State Program	9	CA015312007A	07-31-13
New Mexico	State Program	6	N/A	01-31-13
Northern Mariana Islands	State Program	9	MP0002	01-31-13
Oregon	NELAP	10	4005	09-12-13
USDA	Federal		P330-09-00080	06-06-14
USEPA UCMR	Federal	1	CA01531	01-31-15

Method Summary

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Method	Method Description	Protocol	Laboratory
6010B	Metals (ICP)	SW846	TAL IRV
7470A	Mercury (CVAA)	SW846	TAL IRV
7471A	Mercury (CVAA)	SW846	TAL IRV

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL IRV = TestAmerica Irvine, 17461 Derian Ave, Suite 100, Irvine, CA 92614-5817, TEL (949)261-1022

Sample Summary

Client: Tetra Tech BAS, Inc.
Project/Site: [none]

TestAmerica Job ID: PWA0759

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
PWA0759-01	Crushed Solar Panel #2	Soil	12/06/12 08:00	01/14/13 08:57
PWA0759-02	Crushed Solar Panel #5	Soil	12/06/12 08:00	01/14/13 08:57

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TAL-0013-550 (10/10)

CHAIN OF CUSTODY FORM

[ ] Phoenix - 4625 E. Cotton Center Blvd., Suite 189, Phoenix, AZ 85040 (602) 437-3340 FAX (602) 454-9303
[ ] Tucson - 1870 W. Prince Road, Suite 59, Tucson, AZ 85705 (520) 807-3801 FAX (520) 807-3803
[ ] Las Vegas - 6000 S Eastern Ave., Suite 5E, Las Vegas, NV 89119 (702) 429-1264

1/24/2013

Client Name/Address:	Project/PO Number:
Tetra Tech BAS, Inc 3822 E. Univ. Dr., Ste. 2 Phx, AZ 85034	
Project Manager: Keith A. Johnson	**Phone Number:** 602 2670736
Sampler: "	**Fax Number:**

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: EPA 6010B ICP Lead	STLC dissolved (17)	TCLP Metals (8)	TCLP by EPA 1311	TTLC Com Metals (17)	TTLC Extraction				Special Instructions
Crushed Solar Panel #2				12/6/12			✓	✓	✓	✓	✓	✓		PWA0759-		01
Crushed Solar Panel #5				12/6/12			✓	✓	✓	✓	✓	✓				02

Relinquished By:	Date/Time:	Received By:	Date/Time:	Turnaround Time: (Check)	
Todd Livermore	1/14/13 8:57am			same day ____	72 hours ____
Relinquished By:	Date/Time:	Received By:	Date/Time:	24 hours ____	5 days ____
				48 hours ____	normal ✓
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time:	Sample Integrity: (Check)	
			1/14/13 8:57	intact ✓	on ice No

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

20.3°C

EHS Comparison of Thin Film and Silicon Photovoltaics

First Solar

First Solar Facts & Figures

17GW+
SOLD WORLDWIDE

16.9%+
PRODUCTION MODULE EFFICIENCY

99%+
POWER PLANT FLEET SYSTEM AVAILABILITY ON 5GW+ MONITORED

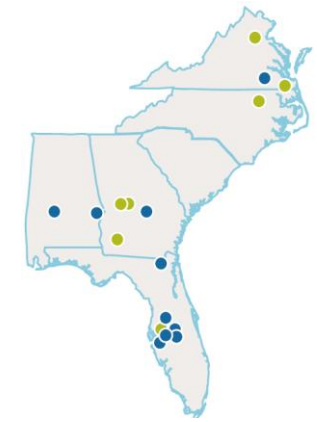
~$14.5B
FIRST SOLAR FACILITATED FINANCING

$3.0B
2017 REVENUE

~4,100
EMPLOYEES WORLDWIDE

SOUTHEASTERN PROJECTS TOTAL: +1,300 MW
featuring First Solar modules and Development, Construction, and/or O&M services*

OPERATING	429 MW
UNDER CONSTRUCTION:	- MW
IN DEVELOPMENT:	876 MW



Product life cycle stage	Environmental, health & safety (EHS) data	Thin Film CdTe PV	Silicon PV
Manufacturing	Quality, environmental, health & safety standards	ISO 9001, ISO 14001, ISO 45001	
	Product composition[1]	97% glass, 3% polymer, 0.13% semiconductor (<0.1% cadmium content)	76% glass, 10% polymer, 8% aluminum, 5% silicon, 1% copper, <0.1% silver, tin, lead
Use	Reliability & durability standards	UL 1703, IEC 61215, IEC 61730	
	Operations and Maintenance	Power output forecasting and monitoring, and visual inspection	
End-of-Life	Tested for disposal[2]	TCLP[3] (22% of cadmium limit)	TCLP[3] (60-220% of lead limit)
	Commercial recycling	First Solar Recycling, SEIA National PV Recycling Program	SEIA National PV Recycling Program
	Decommissioning cost	Columbia University, ERM	Oak Ridge National Lab
Overall	EHS impact assessments	BNL/NREL, NC State University	NC State University

[1] http://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels
[2] http://dx.doi.org/10.1109/JPHOTOV.2015.2479459
[3] USEPA Method 1311 Toxicity Characteristic Leaching Procedure (TCLP)

THIN FILM PHOTOVOLTAIC TECHNOLOGY FAQ

Q: WHAT MAKES FIRST SOLAR'S THIN FILM PV MODULES COMPETITIVE?

A: First Solar thin film modules are manufactured using a fully integrated and resource efficient process which enables affordable, high volume production with the lowest environmental impacts in the industry. In addition, First Solar's high efficiency thin film modules are proven to deliver more usable energy per watt than conventional silicon-based modules, resulting in a lower levelized cost of electricity ($/MWh).

Source: Dirnberger et al., "On the impact of solar spectral irradiance on the yield of different PV technologies," Solar Energy Materials & Solar Cells, vol. 132 pp. 431–442, 2015.

Q: WHAT ARE THE ENVIRONMENTAL BENEFITS OF THIN FILM PV TECHNOLOGY?

A: First Solar's advanced thin film PV solutions are the industry's leading eco-efficient technology due to their superior energy yield, competitive cost and smallest life cycle environmental impacts. By using less grid electricity during manufacturing, First Solar modules have the smallest carbon footprint, fastest energy payback time and lowest life cycle water use and air pollutant emissions of any PV technology.

Sources: Louwen, Atse, Ruud E.I. Schropp, Wilfried G.J.H.M. van Sark, and André P.C. Faaij. "Geospatial Analysis of the Energy Yield and Environmental Footprint of Different Photovoltaic Module Technologies". Solar Energy 155 (October 2017): 1339–53. https://doi.org/10.1016/j.solener.2017.07.056.

Leccisi, Enrica, Marco Raugei, and Vasilis Fthenakis. "The Energy and Environmental Performance of Ground-Mounted Photovoltaic Systems—A Timely Update". Energies 9, Nr. 8 (08 August 2016): 622. https://doi.org/10.3390/en9080622.

Q: HOW DOES CDTE DIFFER FROM CADMIUM?

A: First Solar modules contain cadmium telluride (CdTe) which is a stable compound that is insoluble in water and has an extremely high chemical and thermal stability. These properties limit its bioavailability and potential for exposure. First Solar modules contain very little CdTe. The semiconductor layer in First Solar modules is a few microns thick, equivalent to 3% the thickness of a human hair. Additionally, the thin film semiconductor is encapsulated between two sheets of glass and sealed with an industrial laminate, further limiting the potential for release into the environment in the event of fire or breakage.

Source: Kaczmar, "Evaluating the Read-Across Approach on CdTe Toxicity for CdTe Photovoltaics," in SETAC North America 32nd Annual Meeting, Boston, 2011.

Q: ARE THIN FILM MODULES DURABLE IN THE FIELD?

A: Yes. First Solar modules are tested for safety during breakage, fire, flooding and hail storms, and meet rigorous long-term durability and reliability testing standards. Module breakage is rare and occurs in ~1% of modules over 25 years (0.04% per year), with more than one-third of breakages occurring during shipping and installation. During operation, breakages typically consist of impact fractures whereby the module remains bound together by the industrial laminate.

Source: Sinha, P, and A. Wade. 2015. Assessment of leaching tests for evaluating potential environmental impacts of PV module field breakage. IEEE J. of Photovoltaics, Vol. 5(6), 1710-1714.

Q: IS THIN FILM PV TECHNOLOGY SAFE FOR THE ENVIRONMENT?

A: Yes. More than 40 researchers from leading international institutions have confirmed the environmental benefits and safety of First Solar's thin film PV technology over its entire life cycle; during normal operation, exceptional accidents such as fire or module breakage, and through end-of-life recycling and disposal. First Solar provides the PV technology of choice for leading utilities and power buyers such as Southern Power Co., NRG Energy, and Capital Dynamics. With more than 17,000MW sold worldwide, First Solar modules have a proven record of safe and reliable performance.

Source: http://www.firstsolar.com/Resources/Sustainability-Documents?ty=Peer+Reviews&re=&ln=

Q: CAN FIRST SOLAR MODULES BE RECYCLED AT END-OF-LIFE?

A: Yes. First Solar offers global, competitively-priced and flexible PV module recycling services. First Solar has a long-standing leadership position in PV recycling with over a decade of experience in operating high-value PV recycling facilities on a global and industrial scale. First Solar's high-value recycling process recovers more than 90% of a PV module for reuse in new modules and glass products.

Source: Sinha, Parikhit, Sukhwant Raju, Karen Drozdiak, and Andreas Wade. "Life cycle management and recycling of PV systems". PV Tech, 19 December 2017. https://www.pv-tech.org/technical-papers/life-cycle-management-and-recycling-of-pv-systems.