OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
Managed by ORAU for DOE

October 27, 2016

Mr. John Hickman
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Mailstop T8F5
Rockville, MD 20852

**ORISE CONTRACT NO. DE-SC0014664**
**SUBJECT: LETTER REPORT FOR ANALYTICAL RESULTS FOR SIX SOIL SAMPLES ASSOCIATED WITH THE HUMBOLDT BAY POWER PLANT IN EUREKA, CALIFORNIA**
**[TAC NO. J00338] [DOCKET NO. 50-133](RFTA NO. 16-001)**
**DCN: 5201-LR-04-0**

Dear Mr. Hickman:

Oak Ridge Institute for Science and Education (ORISE) received six soil samples on September 14, 2016 from the Humboldt Bay Power Plant in Eureka, California. ORISE is managed by Oak Ridge Associated Universities(ORAU) under DOE contract number DE-SC0014664. The samples were shipped to the laboratory from the licenssee's laboratory. The samples were received in good condition. Per the chain of custody, the samples were analyzed for gamma emitting isotopes by gamma spectrometry. In addition, per your request, the samples were analyzed for tritium by liquid scintillation counting. The analytical data, along with the procedure references, are presented in the attached reports.

Quality Control (QC) requirements were met for these analyses. The QC files are available for your review upon request.

Please feel free to contact me at 865.576.9184 or Forrest Smith at 865.574.9802 with any questions or comments.

Sincerely,

for Wade Ivey

Wade Ivey
Laboratory Manager
ORAU

WPI:WFS:km:lw

Enclosures

Electronic distribution: T. Carter, NRC; S. Roberts, ORAU; T. Vitkus, ORAU; E. Bailey, ORAU; D. Hagemeyer, ORAU
File code: 5201; Lab code: 12372

| Distribution approval and concurrence: | Initials |
|---|---|
| Quality Review | |
| Technical Review | |

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
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# Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project #:** 201212372 **COC #:** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0757: OOL02-01-002-F

**Lab Sample ID:** 12372S0001 **Smp Qty.:** 646.98 **Units:** grams **Geometry:** LM

**Detector ID:** DET07 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -0.082 | 0.045 | 0.102 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | -0.001 | 0.013 | 0.031 | pCi/g | | U | N/A | N/A |
| Co-60 | 1332.49 | -0.002 | 0.026 | 0.054 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | 0.026 | 0.027 | 0.066 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.128 | 0.027 | 0.034 | pCi/g | 661.71 | | N/A | N/A |
| Eu-152 | 344.28 | 0.003 | 0.054 | 0.124 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.07 | 0.11 | 0.25 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.033 | 0.043 | 0.110 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 11.9 | 1.1 | 0.5 | pCi/g | 1461.09 | | N/A | N/A |
| Mn-54 | 834.85 | 0.025 | 0.018 | 0.038 | pCi/g | 835.96 | U | N/A | N/A |
| Se-75 | 264.66 | -0.015 | 0.022 | 0.050 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 1.40 | 0.44 | 0.63 | pCi/g | 63.22 | | N/A | N/A |
| Zn-65 | 1115.54 | -0.150 | 0.089 | 0.136 | pCi/g | | U | N/A | N/A |

Qualifier Flags:
U = Analyte not detected (< MDC)

TPU = Total Propagated Uncertainty
MDC = Minimum Detectable Concentration

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
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# Gamma Spectrometry Summary Sheet

ORAU
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Report Date: October 24, 2016

**Project # :** 201212372 **COC # :** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0765: OOL02-01-010-F

**Lab Sample ID:** 12372S0002 **Smp Qty.:** 502.55 **Units:** grams **Geometry:** LM

**Detector ID:** DET08 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -0.143 | 0.050 | 0.104 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | -0.001 | 0.012 | 0.029 | pCi/g | | U | N/A | N/A |
| Co-60 | 1332.49 | -0.015 | 0.027 | 0.050 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | 0.049 | 0.026 | 0.064 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.056 | 0.018 | 0.031 | pCi/g | 661.65 | | N/A | N/A |
| Eu-152 | 344.28 | -0.028 | 0.049 | 0.106 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.129 | 0.071 | 0.203 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.007 | 0.051 | 0.120 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 15.3 | 1.3 | 0.7 | pCi/g | 1461.05 | | N/A | N/A |
| Mn-54 | 834.85 | 0.010 | 0.018 | 0.050 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | -0.010 | 0.025 | 0.054 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 2.80 | 0.73 | 0.75 | pCi/g | 63.25 | | N/A | N/A |
| Zn-65 | 1115.54 | -0.079 | 0.061 | 0.113 | pCi/g | | U | N/A | N/A |

Qualifier Flags:
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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** 201212372 **COC # :** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0779: OOL02-01-024-F

**Lab Sample ID:** 12372S0003 **Smp Qty.:** 523.29 **Units:** grams **Geometry:** LM

**Detector ID:** DET09 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -0.080 | 0.043 | 0.097 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | 0.001 | 0.013 | 0.031 | pCi/g | | U | N/A | N/A |
| Co-60 | 1332.49 | -0.003 | 0.025 | 0.049 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | -0.006 | 0.014 | 0.063 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.464 | 0.055 | 0.034 | pCi/g | 661.74 | | N/A | N/A |
| Eu-152 | 344.28 | -0.024 | 0.044 | 0.100 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.15 | 0.11 | 0.22 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.054 | 0.032 | 0.069 | pCi/g | 104.93 | U | N/A | N/A |
| K-40 | 1460.82 | 13.4 | 1.2 | 0.5 | pCi/g | 1461.14 | | N/A | N/A |
| Mn-54 | 834.85 | 0.002 | 0.024 | 0.053 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | -0.008 | 0.024 | 0.057 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 2.06 | 0.58 | 0.69 | pCi/g | 63.19 | | N/A | N/A |
| Zn-65 | 1115.54 | -0.091 | 0.078 | 0.139 | pCi/g | | U | N/A | N/A |

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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** 201212372 **COC # :** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0782: OOL02-01-027-F

**Lab Sample ID:** 12372S0004 **Smp Qty.:** 745.59 **Units:** grams **Geometry:** LM

**Detector ID:** DET10 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -0.025 | 0.087 | 0.212 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | 0.0084 | 0.0100 | 0.0234 | pCi/g | 121.30 | U | N/A | N/A |
| Co-60 | 1332.49 | -0.013 | 0.021 | 0.039 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | 0.039 | 0.022 | 0.055 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.044 | 0.017 | 0.035 | pCi/g | 661.97 | | N/A | N/A |
| Eu-152 | 344.28 | 0.023 | 0.042 | 0.102 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.133 | 0.095 | 0.175 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.037 | 0.052 | 0.133 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 11.1 | 1.0 | 0.6 | pCi/g | 1460.60 | | N/A | N/A |
| Mn-54 | 834.85 | -0.016 | 0.020 | 0.038 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | -0.004 | 0.021 | 0.049 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 0.99 | 0.58 | 1.21 | pCi/g | 63.55 | U | N/A | N/A |
| Zn-65 | 1115.54 | -0.095 | 0.060 | 0.101 | pCi/g | | U | N/A | N/A |

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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** 201212372 **COC # :** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0783: OOL02-01-028-F

**Lab Sample ID:** 12372S0005 **Smp Qty.:** 628.05 **Units:** grams **Geometry:** LM

**Detector ID:** DET07 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/30/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | 0.009 | 0.036 | 0.112 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | 0.009 | 0.014 | 0.034 | pCi/g | | U | N/A | N/A |
| Co-60 | 1332.49 | -0.014 | 0.031 | 0.060 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | 0.025 | 0.031 | 0.074 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.218 | 0.036 | 0.041 | pCi/g | 661.74 | | N/A | N/A |
| Eu-152 | 344.28 | -0.045 | 0.064 | 0.136 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.23 | 0.15 | 0.25 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.059 | 0.047 | 0.122 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 15.2 | 1.4 | 0.6 | pCi/g | 1461.00 | | N/A | N/A |
| Mn-54 | 834.85 | -0.002 | 0.027 | 0.058 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | -0.006 | 0.026 | 0.062 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 0.66 | 0.36 | 0.73 | pCi/g | 63.39 | U | N/A | N/A |
| Zn-65 | 1115.54 | -0.170 | 0.089 | 0.153 | pCi/g | | U | N/A | N/A |

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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** 201212372 **COC # :** 1609-008

**Project Name:** Humboldt Bay PP 09-2016

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:** FSS-0787: OOL02-01-032-F

**Lab Sample ID:** 12372S0006 **Smp Qty.:** 655.82 **Units:** grams **Geometry:** LM

**Detector ID:** DET07 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:** 8/30/2016

**SDG:** 201212372-1

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -0.045 | 0.046 | 0.107 | pCi/g | | U | N/A | N/A |
| Co-57 | 122.06 | 0.0085 | 0.0097 | 0.0227 | pCi/g | 123.06 | U | N/A | N/A |
| Co-60 | 1332.49 | 0.017 | 0.027 | 0.063 | pCi/g | | U | N/A | N/A |
| Cs-134 | 795.86 | 0.002 | 0.031 | 0.065 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 0.478 | 0.054 | 0.040 | pCi/g | 661.88 | | N/A | N/A |
| Eu-152 | 344.28 | 0.024 | 0.054 | 0.134 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.18 | 0.13 | 0.25 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | -0.018 | 0.043 | 0.106 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 12.3 | 1.2 | 0.6 | pCi/g | 1461.00 | | N/A | N/A |
| Mn-54 | 834.85 | 0.006 | 0.027 | 0.059 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | -0.009 | 0.025 | 0.057 | pCi/g | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | 0.70 | 0.35 | 0.69 | pCi/g | 63.26 | | N/A | N/A |
| Zn-65 | 1115.54 | -0.133 | 0.085 | 0.148 | pCi/g | | U | N/A | N/A |

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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** **COC # :**

**Project Name:**

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:**

**Lab Sample ID:** BLK0351S **Smp Qty.:** 1.00 **Units:** sample **Geometry:** LM

**Detector ID:** DET09 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:**

**SDG:**

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | -1.7 | 7.7 | 19.6 | pCi/sample | | U | N/A | N/A |
| Co-57 | 122.06 | -0.9 | 3.3 | 7.9 | pCi/sample | | U | N/A | N/A |
| Co-60 | 1332.49 | -1.8 | 6.9 | 14.8 | pCi/sample | | U | N/A | N/A |
| Cs-134 | 795.86 | -1.7 | 6.2 | 14.1 | pCi/sample | | U | N/A | N/A |
| Cs-137 | 661.66 | 5.1 | 6.4 | 17.0 | pCi/sample | | U | N/A | N/A |
| Eu-152 | 344.28 | 3 | 14 | 35 | pCi/sample | | U | N/A | N/A |
| Eu-154 | 723.30 | -14 | 30 | 66 | pCi/sample | | U | N/A | N/A |
| Eu-155 | 105.31 | 12 | 11 | 30 | pCi/sample | | U | N/A | N/A |
| K-40 | 1460.82 | -11 | 84 | 226 | pCi/sample | 1461.09 | U | N/A | N/A |
| Mn-54 | 834.85 | -2.5 | 6.3 | 12.5 | pCi/sample | | U | N/A | N/A |
| Se-75 | 264.66 | -2.4 | 6.1 | 14.1 | pCi/sample | | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | -27 | 59 | 158 | pCi/sample | 63.48 | U | N/A | N/A |
| Zn-65 | 1115.54 | -8 | 15 | 28 | pCi/sample | | U | N/A | N/A |

Qualifier Flags:
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## Gamma Spectrometry Summary Sheet

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Report Date: October 24, 2016

**Project # :** **COC # :**

**Project Name:**

**Batch Number:** GS0351 **Analyst:** smithw

**Client Sample ID:**

**Lab Sample ID:** LCS0351S **Smp Qty.:** 514.39 **Units:** grams **Geometry:** 250LM

**Detector ID:** DET08 **Live Time(s):** 3,600 **SOP (Rev. #):** CP1 (20)

**Count Date:** 9/28/2016 **Receipt Date:** 9/14/2016 **Collection Date:**

**SDG:**

| Analyte | Energy Signature (keV) | Result | TPU (2s) | MDC | Units | Energy (keV) | Qualifier | Duplicate Error Ratio | Meas./Known Activity Ratio |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 59.54 | 9.04 | 0.27 | 0.12 | pCi/g | 59.45 | | N/A | 0.96 |
| Co-57 | 122.06 | 2.96 | 0.35 | 0.59 | pCi/g | 121.95 | | N/A | N/A |
| Co-60 | 1332.49 | 5.62 | 0.25 | 0.12 | pCi/g | 1332.69 | | N/A | N/A |
| Cs-134 | 795.86 | 0.07 | 0.14 | 0.29 | pCi/g | | U | N/A | N/A |
| Cs-137 | 661.66 | 3.73 | 0.25 | 0.07 | pCi/g | 661.67 | | N/A | 0.95 |
| Eu-152 | 344.28 | 0.051 | 0.089 | 0.202 | pCi/g | | U | N/A | N/A |
| Eu-154 | 723.30 | -0.13 | 0.20 | 0.40 | pCi/g | | U | N/A | N/A |
| Eu-155 | 105.31 | 0.122 | 0.097 | 0.234 | pCi/g | | U | N/A | N/A |
| K-40 | 1460.82 | 0.14 | 0.20 | 0.47 | pCi/g | 1461.21 | U | N/A | N/A |
| Mn-54 | 834.85 | -0.57 | 0.66 | 1.26 | pCi/g | | U | N/A | N/A |
| Se-75 | 264.66 | 35 | 35 | 81 | pCi/g | 263.79 | U | N/A | N/A |
| U-238 by Th-234 | 63.29 | -14.6 | 3.5 | 1.0 | pCi/g | | U | N/A | N/A |
| Zn-65 | 1115.54 | -0.1 | 3.1 | 7.1 | pCi/g | | U | N/A | N/A |

**Electronically Validated By:**
Roxanne Nagle- 10/5/2016 09:23

**Electronically Approved By:**

Wade A. Ivey

Wade Ivey 10/24/2016 13:01

Qualifier Flags:
U = Analyte not detected (< MDC)

TPU = Total Propagated Uncertainty
MDC = Minimum Detectable Concentration

Liquid Scintillation Analysis Summary Results by Analyte

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Analyte: H-3 SOP (Rev. #): AP6 (21) Report Date: 10/11/2016
Project Name: Humboldt Bay PP 09-2016
Project #: 201212372 SDG #: 201212372-1

| Client Sample ID | Lab Sample ID | Result | TPU(2s) | MDC | Units | Qualifier Flag | Batch # |
|---|---|---|---|---|---|---|---|
| FSS-0757:OOL02-01-002-F | 12372S0001 | 0.6 | 3.4 | 5.9 | pCi/g | U | HB0362 |
| FSS-0765:OOL02-01-010-F | 12372S0002 | -0.9 | 2.9 | 5.2 | pCi/g | U | HB0362 |
| FSS-0765:OOL02-01-010-F | 12372S0002Dup | 0.2 | 2.8 | 4.9 | pCi/g | U | HB0362 |
| FSS-0779:OOL02-01-024-F | 12372S0003 | -1.4 | 2.1 | 3.8 | pCi/g | U | HB0362 |
| FSS-0782:OOL02-01-027-F | 12372S0004 | -0.9 | 2.7 | 4.8 | pCi/g | U | HB0362 |
| FSS-0783:OOL02-01-028-F | 12372S0005 | 0.2 | 2.9 | 5.0 | pCi/g | U | HB0362 |
| FSS-0787:OOL02-01-032-F | 12372S0006 | -0.5 | 2.6 | 4.6 | pCi/g | U | HB0362 |

Validated By: [signature]
Date: 10-12-16
Approved By: [signature]
Date: 10/24/16

Qualifier Flags:
U= Analyte not detected (<MDC)

TPU= Total Propagated Uncertainty
MDC= Minimum Detectable Concentration