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February 9, 2016

Dennis Keller
Facilities Manager
Fairfield County Board of Commissioners
210 East Main Street, Room 406
Lancaster, Ohio 43130-3879

Re: Update to the January 29, 2016 Letter on Specific
Conductance and Other Water Quality Parameters in
the Groundwater at the
Future Fairfield County Jail/Public Safety Facility Site
and the Adjacent City of Lancaster Miller Park
Wellfield Wells

Dear Mr. Keller:

On January 29, 2016, Bennett & Williams prepared a letter to provide additional information regarding water quality in monitoring wells MW-9S and MW-9D that were installed by Fairfield County on the site of the future Fairfield County Jail/Public Safety Facility at the request of the City of Lancaster. This letter contained information based on water quality results collected by the City of Lancaster in these monitoring wells from April 2015 through December 2015) in addition to raw water samples collected in pumping wells #15 and #23 in the Miller Park Wellfield. Since that time, one additional sample has been collected in MW9S, MW-9D, Well #15 and Well #23 by the City of Lancaster. The purpose of this letter is to update the information contained in the January 29, 2016 letter to include these results in the discussion.

Statistics Discussion

In general, the conclusions reached in our January 29, 2016 letter remain valid. First, the water in the two production wells (Well #15 and Well #23) remains statistically different. However, the following changes were noted in our analyses:

- 1) Using the 2015 dataset alone, arsenic, barium, calcium, magnesium, manganese, potassium and sodium (all seven parameters for which data was available) were statistically different in the two production wells; and
- 2) Using the 2015 dataset and the one analysis from 2016, arsenic, barium, calcium, magnesium and manganese (five of the seven parameters for which data was available) remained statistically different.

Second, the water quality in monitoring well MW-9D appeared directly influenced by the production well that was pumping at the time of sample collection. However, the following changes were noted in our analyses:

- 1) Using the 2015 dataset alone, calcium, magnesium, manganese, potassium and sodium (five of the seven parameters for which data was available) were statistically different in MW-9D when a different production well (#15 or #23) was pumping;
- 2) Using the 2015 dataset and the one analysis from 2016, barium, calcium, magnesium, manganese, potassium and sodium (six of the seven parameters for which data was available) were now statistically when a different production well (#15 or #23) was pumping.

The complete dataset is included as Attachment 1. The updated analyses are presented in Tables 1 and 2 in Attachment 2.

Arsenic Discussion

In addition to the water quality discussed in the January 29, 2016 letter, it should be noted that values for arsenic in monitoring wells MW-9S and MW-9D (11 ug/L and 13 ug/L respectively) both exceeded the maximum contaminant level (MCL) for drinking water for the first time in the sample collected on January 20, 2016. The five-page December 8, 2015 letter to Michael Nixon, Superintendent, City of Lancaster from Michael E. Leone, and Thomas J. Mignery, Burgess & Niple, contained a relatively complete discussion of regional and local arsenic concentrations and the variability of arsenic in groundwater. Of specific note was the presence of an average concentration of arsenic in production well #28 of 12 ug/L for the measured time period of March 5, 1992 through September 23, 2014 (22 samples) and a maximum concentration of 18 ug/L. Despite the fact that the average concentration in production well #28 is in excess of the MCL, Consumer Confidence Reports for 2009 through 2014 prepared by the City of Lancaster showed that arsenic was not reported as detected in the finished water from the Miller Park Wellfield. This is likely due to removal of the arsenic by the ion exchange treatment used to reduce hardness from approximately 450 mg/L to a target of 150 mg/L.

Similarly, the City of Lancaster has a Source Water Protection Monitoring Well Network that consists of 14 monitoring wells (including MW-9S and MW-9D). With the exception of MW-9S and MW-9D, these monitoring wells were sampled from October 1995 through April 2015. Arsenic concentrations in the monitoring wells during this 20-year period have varied considerably, as shown in Table 3. This table is updated from the table in Attachment 3 of the December 8, 2015 Burgess & Niple letter. As shown in Table 3, only two monitoring wells, MW-6S and MW-8 have never had a detection of arsenic. All the other monitoring wells have had detections of arsenic – and all the other monitoring wells have at least one detection greater than the MCL of 10 ug/L. Further, half of the monitoring wells with detections of arsenic have arsenic concentrations greater than 10 ug/L greater than 50 percent of the time.

Table 3. Arsenic concentrations in the Source Water Protection monitoring well network for the City of Lancaster, Ohio (March 1992 through April 2015).

| Well Number | Number of Samples | Percent ND | Minimum ug/L | Maximum ug/L | Number of values > 10 ug/L | Percent values >10 ug/L |
|-------------|-------------------|------------|--------------|--------------|----------------------------|-------------------------|
| MW-1S | 31 | 22.6% | ND | 12 | 2 | 6.5% |
| MW-1D | 31 | 6.5% | ND | 16 | 19 | 61.3% |
| MW-2 | 31 | 41.9% | ND | 18 | 2 | 6.5% |
| MW-3 | 31 | 6.5% | ND | 28 | 27 | 87.1% |
| MW-4S | 31 | 0.0% | 1.7 | 57 | 23 | 74.2% |
| MW-4D | 31 | 12.9% | ND | 13 | 4 | 12.9% |
| MW-5S | 31 | 90.3% | ND | 13 | 1 | 3.2% |
| MW-5D | 24 | 0.0% | 7 | 53 | 23 | 95.8% |
| MW-6S | 25 | 100.0% | ND | ND | 0 | 0.0% |
| MW-6D | 31 | 6.5% | ND | 20 | 20 | 64.5% |
| MW-7 | 31 | 3.2% | ND | 30 | 28 | 90.3% |
| MW-8 | 31 | 100.0% | ND | ND | 0 | 0.0% |
| MW-9S | 8 | 0.0% | 5 | 11 | 1 | 12.5% |
| MW-9D | 8 | 0.0% | 6 | 13 | 1 | 12.5% |

This historical data as well as other data for this area of Ohio pertaining to arsenic shows that the concentrations of arsenic are variable in groundwater in and around the Miller Park wellfield. The concentrations of arsenic collected on January 20, 2016 in MW-9S and MW-9D, although above the drinking water standard of 10 ug/L, are not uncharacteristic of water quality that has been present in and around the wellfield for the last 20 years. At this time, the data does not indicate that the construction activities at the jail site are a significant source of additional arsenic in the groundwater.

If you have questions, please do not hesitate to contact us.

Respectfully submitted
 BENNETT & WILLIAMS
 ENVIRONMENTAL CONSULTANTS, INC.



Linda Aller, CPG, RS
 Principal Geologist



Kerry Zwierschke, PhD., P.E.
 Principal Engineer

LA/lka

Attachments (2)

I:\Projects\14-04:Correspondence\2-9-16 Update to 1-29-16 WQ ltr

ATTACHMENT 1
WATER QUALITY RESULTS
PRODUCTION WELLS #15 AND #23
MONITORING WELLS MW-9S AND MW-9D
THROUGH JANUARY 2016

City of Lancaster, Ohio
Division of Water
Historical Groundwater Quality Data

| PARAMETERS | Units | MCL/SMCL/ ACTION LEVEL | Well #15 | | | | |
|--------------------------------|--------|---------------------------|----------|--------|--------|--------|--------|
| | | | Sep-15 | Oct-15 | Nov-15 | Dec-15 | Jan-16 |
| INORGANICS | | | | | | | |
| ALUMINIUM | mg/L | 50 to 200 (S) | ND | ND | ND | ND | ND |
| ANTIMONY | ug/L | 6 | ND | ND | ND | ND | ND |
| ARSENIC | ug/L | 10.0 | 4 | 4 | ND | 5 | 8 |
| BARIIUM | ug/L | 2000 | 97 | 99 | 104 | 98 | 113 |
| BERYLLIUM | ug/L | 4.0 | ND | ND | ND | ND | ND |
| CADMIUM | ug/L | 5.0 | ND | ND | ND | ND | ND |
| CALCIUM | mg/L | -- | 120 | 120 | 127 | 125 | 130 |
| CHROMIUM | ug/L | 100 | ND | ND | ND | ND | ND |
| COBALT | ug/L | -- | ND | ND | ND | ND | ND |
| COPPER | ug/L | 1000 (S) / 1300 (A) | ND | ND | ND | ND | ND |
| CYANIDE | mg/L | 0.2 | ND | ND | ND | ND | ND |
| IRON | ug/L | 300 (S) | ND | 275 | ND | ND | 792 |
| LEAD | ug/L | 15 (A) | ND | ND | ND | ND | ND |
| MAGNESIUM | mg/L | -- | 32.5 | 33.5 | 33.9 | 33.8 | 36.5 |
| MANGANESE | ug/L | 50 (S) | 216 | 215 | 211 | 221 | 217 |
| MERCURY | ug/L | 2.0 | ND | ND | ND | ND | ND |
| NICKEL | ug/L | -- | ND | ND | ND | ND | ND |
| POTASSIUM | mg/L | -- | 5.3 | 5.2 | 5.1 | 5.2 | 6.6 |
| SELENIUM | ug/L | 50.0 | ND | ND | ND | ND | ND |
| SILVER | ug/L | 100 (S) | ND | ND | ND | ND | ND |
| SODIUM | mg/L | -- | 58.9 | 53.4 | 55.3 | 54.9 | 65.7 |
| SULFIDE | mg/L | -- | ND | ND | ND | ND | ND |
| THALLIUM | ug/L | 2.0 | ND | ND | ND | ND | ND |
| TIN | ug/L | -- | ND | ND | ND | ND | ND |
| VANADIUM | mg/L | -- | ND | ND | ND | ND | ND |
| ZINC | ug/L | 5000 (S) | ND | ND | ND | ND | ND |
| VOLATILE ORGANICS VOC'S | | | | | | | |
| Method 8260 | Varies | Varies | ND | ND | ND | ND | ND |
| | | | | | | | |

(S) = Secondary Maximum Contaminant Level

(A) = Action Level

(O) = Ohio EPA Primary Maximum Contaminant Level

D = DETECTED

ND = NOT DETECTED

NA = NOT ANALYZED

NM = NOT MEASURED

City of Lancaster, Ohio
Division of Water
Historical Groundwater Quality Data

| PARAMETERS | Units | MCL/SMCL/ ACTION LEVEL | Well #23 | | | | |
|--------------------------------|--------|---------------------------|-------------|--------------|-------------|-------------|-------------|
| | | | Sep-15 | Oct-15 | Nov-15 | Dec-15 | Jan-16 |
| INORGANICS | | | | | | | |
| ALUMINUM | mg/L | 50 to 200 (S) | ND | ND | ND | ND | ND |
| ANTIMONY | ug/L | 6 | ND | ND | ND | ND | ND |
| ARSENIC | ug/L | 10.0 | 7 | 9 | 7 | 9 | 8 |
| BARIUM | ug/L | 2000 | 79 | 74 | 69 | 84 | 81 |
| BERYLLIUM | ug/L | 4.0 | ND | ND | ND | ND | ND |
| CADMIUM | ug/L | 5.0 | ND | ND | ND | ND | ND |
| CALCIUM | mg/L | -- | 136 | 134 | 138 | 140 | 134 |
| CHROMIUM | ug/L | 100 | ND | ND | ND | ND | ND |
| COBALT | ug/L | -- | ND | ND | ND | ND | ND |
| COPPER | ug/L | 1000 (S) / 1300 (A) | ND | ND | ND | ND | ND |
| CYANIDE | mg/L | 0.2 | ND | ND | ND | ND | ND |
| IRON | ug/L | 300 (S) | ND | 460 | ND | 292 | 782 |
| LEAD | ug/L | 15 (A) | ND | ND | ND | ND | ND |
| MAGNESIUM | mg/L | -- | 36.3 | 37.4 | 35.8 | 36.0 | 37.9 |
| MANGANESE | ug/L | 50 (S) | 270 | 279 | 263 | 260 | 220 |
| MERCURY | ug/L | 2.0 | ND | ND | ND | ND | ND |
| NICKEL | ug/L | -- | ND | ND | ND | ND | ND |
| POTASSIUM | mg/L | -- | 5.8 | 5.9 | 5.4 | 5.6 | 5.1 |
| SELENIUM | ug/L | 50.0 | ND | ND | ND | ND | ND |
| SILVER | ug/L | 100 (S) | ND | ND | ND | ND | ND |
| SODIUM | mg/L | -- | 67.8 | 67.0 | 66.4 | 66.9 | 55.6 |
| SULFIDE | mg/L | -- | ND | ND | ND | ND | ND |
| THALLIUM | ug/L | 2.0 | ND | ND | ND | ND | ND |
| TIN | ug/L | -- | ND | ND | ND | ND | ND |
| VANADIUM | mg/L | -- | ND | ND | ND | ND | ND |
| ZINC | ug/L | 5000 (S) | 28.0 | 22.00 | ND | ND | ND |
| VOLATILE ORGANICS VOC'S | | | | | | | |
| Method 8260 | Varies | Varies | ND | ND | ND | ND | ND |

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City of Lancaster, Ohio
Division of Water
Miller Park Wellhead Protection Program
Historical Groundwater Quality Data

| PARAMETERS | Units | MCL/SMCL/ ACTION LEVEL | MW-9D | | | | | | | |
|---------------------------------|------------------------|---------------------------|--------|---------|----------|---------|----------|---------|----------|---------|
| | | | 4/1/15 | 10/7/15 | 10/20/15 | 11/4/15 | 11/18/15 | 12/2/15 | 12/16/15 | 1/20/16 |
| INORGANICS | | | | | | | | | | |
| ALUMINUM | mg/L | 50 to 200 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| ANTIMONY | ug/L | 6 | ND | ND | ND | ND | ND | ND | ND | ND |
| ARSENIC | ug/L | 10.0 | 7 | 8 | 8 | 6 | 9 | 9 | 6 | 13 |
| BARIUM | ug/L | 2000 | 74 | 78 | 73 | 74 | 135 | 123 | 68 | 108 |
| BERYLLIUM | ug/L | 4.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| CADMIUM | ug/L | 5.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| CALCIUM | mg/L | -- | 123 | 118 | 109 | 108 | 149 | 145 | 126 | 133 |
| CHROMIUM | ug/L | 100 | ND | ND | ND | ND | ND | ND | ND | ND |
| COBALT | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| COPPER | ug/L | 1000 (S) / 1300 (A) | ND | ND | ND | ND | ND | ND | ND | ND |
| CYANIDE | mg/L | 0.2 | ND | ND | ND | ND | ND | ND | ND | ND |
| IRON | ug/L | 300 (S) | 934 | 298 | 1200 | ND | 374 | 1570 | 321 | 1830 |
| LEAD | ug/L | 15 (A) | ND | ND | ND | ND | ND | ND | ND | ND |
| MAGNESIUM | mg/L | -- | 34.7 | 33.0 | 29.8 | 31.7 | 39.4 | 37.3 | 32.9 | 34.7 |
| MANGANESE | ug/L | 50 (S) | 339 | 261 | 276 | 241 | 370 | 392 | 318 | 308 |
| MERCURY | ug/L | 2.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| NICKEL | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| POTASSIUM | mg/L | -- | 6.8 | 3.2 | 3.2 | 3.0 | 7.2 | 7.7 | 4.3 | 5.4 |
| SELENIUM | ug/L | 50.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| SILVER | ug/L | 100 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| SODIUM | mg/L | -- | 69.1 | 22.0 | 22.7 | 20.0 | 87.5 | 99.6 | 56.4 | 62.7 |
| SULFIDE | mg/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| THALLIUM | ug/L | 2.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| TIN | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| VANADIUM | mg/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| ZINC | ug/L | 5000 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| VOLATILE ORGANICS VOC'S | | | | | | | | | | |
| Method 8260 | Varies | Varies | ND | D | ND | ND | ND | ND | ND | ND |
| 10/7/15 - CHLOROFORM 1.5 | | | | | | | | | | |
| FIELD PARAMETERS | | | | | | | | | | |
| STATIC WATER LEVEL | * from reference point | | 19.45 | 23.24 | 23.04 | 23.08 | 21.40 | 21.22 | 21.98 | 20.31 |
| TEMPERATURE | °C | -- | 16.7 | 16.1 | 15.8 | 16.0 | 16.7 | 16.5 | 15.9 | 15.2 |
| pH | S.U. | 6.5-8.5 (S) | 7.11 | 7.21 | 7.20 | 7.20 | 7.07 | 6.94 | 7.05 | 7.04 |
| CONDUCTIVITY | umhos/cm | -- | 993 | 810 | 829 | 815 | 1309 | 1415 | 1230 | 1274 |

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City of Lancaster, Ohio
Division of Water
Miller Park Wellhead Protection Program
Historical Groundwater Quality Data

| PARAMETERS | Units | MCL/SMCL/ ACTION LEVEL | MW-9S | | | | | | | |
|--|------------------------|---------------------------|--------|---------|----------|---------|----------|---------|----------|---------|
| | | | 4/1/15 | 10/7/15 | 10/20/15 | 11/4/15 | 11/18/15 | 12/2/15 | 12/16/15 | 1/20/16 |
| INORGANICS | | | | | | | | | | |
| ALUMINUM | mg/L | 50 to 200 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| ANTIMONY | ug/L | 6 | ND | ND | ND | ND | ND | ND | ND | ND |
| ARSENIC | ug/L | 10.0 | 5.0 | 9.0 | 7.0 | 6.0 | 6.0 | 7.0 | 5.0 | 11.0 |
| BARIUM | ug/L | 2000 | 399 | 459 | 405 | 413 | 393 | 419 | 422 | 475 |
| BERYLLIUM | ug/L | 4.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| CADMIUM | ug/L | 5.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| CALCIUM | mg/L | -- | 166 | 163 | 142 | 144 | 144 | 157 | 164 | 179 |
| CHROMIUM | ug/L | 100 | ND | ND | ND | ND | ND | ND | ND | ND |
| COBALT | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| COPPER | ug/L | 1000 (S) / 1300 (A) | ND | ND | ND | ND | ND | ND | ND | ND |
| CYANIDE | mg/L | 0.2 | ND | ND | ND | ND | ND | ND | ND | ND |
| IRON | ug/L | 300 (S) | 446 | 1830 | 1660 | 293 | 139 | 798 | 689 | 2160 |
| LEAD | ug/L | 15 (A) | ND | ND | ND | ND | ND | ND | ND | ND |
| MAGNESIUM | mg/L | -- | 44.3 | 44.0 | 39.1 | 42.4 | 45.6 | 46.0 | 44.5 | 50.8 |
| MANGANESE | ug/L | 50 (S) | 204 | 142 | 133 | 128 | 144 | 147 | 140 | 140 |
| MERCURY | ug/L | 2.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| NICKEL | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| POTASSIUM | mg/L | -- | 30.1 | 19.4 | 17.8 | 17.6 | 16.9 | 16.8 | 16.9 | 18.2 |
| SELENIUM | ug/L | 50.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| SILVER | ug/L | 100 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| SODIUM | mg/L | -- | 302.0 | 272.0 | 243.0 | 212.0 | 176.0 | 188.0 | 184.0 | 166.0 |
| SULFIDE | mg/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| THALLIUM | ug/L | 2.0 | ND | ND | ND | ND | ND | ND | ND | ND |
| TIN | ug/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| VANADIUM | mg/L | -- | ND | ND | ND | ND | ND | ND | ND | ND |
| ZINC | ug/L | 5000 (S) | ND | ND | ND | ND | ND | ND | ND | ND |
| VOLATILE ORGANICS VOC'S | | | | | | | | | | |
| Method 8260 | Varies | Varies | ND | ND | ND | ND | D | D | D | D |
| 11/18-MTBE 1.1ug/l, 12/4-MTBE 1.5ug/l, 12/16-MTBE 1.2ug/l, 1/20-MTBE 1.2ug/l | | | | | | | | | | |
| FIELD PARAMETERS | | | | | | | | | | |
| STATIC WATER LEVEL | * from reference point | | 18.86 | 21.24 | 21.99 | 22.44 | 21.29 | 20.40 | 20.36 | 20.15 |
| TEMPERATURE | °C | -- | 18.1 | 17.4 | 17.1 | 17.4 | 17.4 | 17.1 | 18.0 | 16.9 |
| pH | S.U. | 6.5-8.5 (S) | 6.95 | 6.97 | 7.00 | 6.97 | 6.96 | 6.88 | 6.89 | 6.85 |
| CONDUCTIVITY | umhos/cm | -- | 2280 | 2340 | 2170 | 2010 | 1941 | 1947 | 1970 | 1870 |

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ATTACHMENT 2
STATISTICAL ANALYSIS SUMMARIES

Table 1. Comparison of groundwater quality in Well #15 and Well #23 (data from September 2015 through January 2016).

| Parameter | Mean Concentration | | F-value+ | P-value^ |
|-------------------------|--------------------|----------|----------|----------------|
| | Well #15 | Well #23 | | |
| Arsenic (µg/L) | 5.25* | 8.00 | 7.98 | 0.02562 |
| Barium (µg/L) | 102.2 | 77.4 | 38.93 | 0.00025 |
| Calcium (mg/L) | 124.4 | 136.4 | 27.59 | 0.00077 |
| Magnesium (mg/L) | 34.04 | 36.68 | 11.44 | 0.00960 |
| Manganese (µg/L) | 216 | 258.4 | 17.05 | 0.00330 |
| Potassium (mg/L) | 5.48 | 5.56 | 0.064 | 0.80666 |
| Sodium (mg/L) | 57.64 | 64.74 | 4.97 | 0.05639 |

*nondetect value (November 2015) in Well #15 was omitted from this analysis because the detection limit was not provided.

+The F-value is the ratio of two mean squares that are used in the statistical calculation of the P-value.

^P-values less than 0.05 indicate that the water quality in Well #15 is statistically significantly different from the water quality in Well #23.

Table 2. Comparison of water quality in MW-9D when Well #15 and Well #23 are pumping (data from April 2015 through January 2016).

| Parameter | Mean Concentration | | F-value+ | P-value^ |
|-------------------------|--------------------|------------------|----------|---------------|
| | Well #15 pumping | Well #23 pumping | | |
| Arsenic (µg/L)* | 7.0 | 9.5 | 3.261 | 0.1209 |
| Barium (µg/L) | 73.3 | 110 | 7.556 | 0.0333 |
| Calcium (mg/L) | 115.3 | 137.5 | 9.374 | 0.0222 |
| Magnesium (mg/L) | 31.9 | 36.53 | 11.826 | 0.0138 |
| Manganese (µg/L) | 274 | 352.3 | 10.167 | 0.0189 |
| Potassium (mg/L) | 3.4 | 6.78 | 33.879 | 0.0011 |
| Sodium (mg/L) | 30.3 | 79.73 | 16.558 | 0.0066 |

+The F-value is the ratio of two mean squares that are used in the statistical calculation of the P-value.

^P-values less than 0.05 indicate that the water quality in MW-9D when Well #15 is pumping is statistically significantly different from the water quality in MW-9D when Well #23 is pumping.