

SEDIMENT SAMPLE ANALYSIS

West Branch DuPage River

West Chicago, IL

Prepared For:

Kerr McGee Chemical Corporation

Prepared By:

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INTRODUCTION:

Thirty one sediment samples were collected from the West branch of the DuPage River in West Chicago, Illinois. These samples were analyzed for natural uranium and thorium which may have been deposited into the river as a result of operations at the West Chicago sewage treatment plant. All sediment samples, with the exception of a sample taken at the discharge point from the sewage treatment plant, showed uranium and thorium (and daughters) concentration at background levels. The one sample at the plant discharge point showed thorium concentrations of 30 pCi/g.

SAMPLE METHODOLOGY:

Two sediment samples were taken from 15 points along the river. Each of these pairs consisted of samples taken several feet in from the east and west banks. Each sample pair was separated by 400 feet (as measured down the center of the river) beginning 400 feet upstream of the West Chicago sewage treatment plant (STP). The second sample pair was collected at the discharge point from the STP. In addition, one background sample was collected approximately 800 yards upstream of the STP.

The samples were collected using a hand trowel. Each sample was taken from the entire depth of sediment (down to stream bed gravel) if possible. At each sampling point, sediment characteristics were noted. These characteristics are listed in Appendix B. The samples were sealed in plastic bags and taken to the RMC office for preparation and analysis.

SAMPLE ANALYSIS:

The sediment samples were dried and crushed. The fine portion (grain size less than 3 mm) of each sample was then sealed into 300 ml aluminum can for analysis. The analysis was performed three weeks after canning the samples to allow Pb-214 and Bi-214 to grow into equilibrium with Rn-222.

Each samples was analyzed for U-238, Th-232 and daughters using an intrinsic germanium (IG) based gamma spectroscopy system. The components of this system are listed in Appendix A.

The IG detector was calibrated using a NBS mixed gamma standard solution (SRM 4276 B), and aliquant of which was mixed in a plaster matrix and sealed into a 300 ml can to match the sample counting geometry. A mixed gamma check source (Cd-109, Cs-137, Co-60) was used to verify system stability. Background counts were made using an empty 300 ml can.

Minimum detectable activity (MDA) for photopeaks used were calculated using the following formula:

$$\text{MDA (pCi)} = 4.65 \sqrt{\text{RB/TB}} * 27.03 * \text{ABD}^{-1} * \text{EFF}^{-1}$$

where: RB = background count rate (counts/second)
TB = background count time (second)
ABD = gamma emission rate (gamma/disintegration)
EFF = counter efficiency (counts/gamma)
27.03 = pCi/counts/second

MDA's for photopeaks used in the analysis are shown in Table 1.

Neither U-235 or Th-232 emit photons when disintegrating. Therefore, their activity was inferred by analysis for Th-234 and Ac-228. U-235 activity was measured by its 144 kev photon. Ra-226 activity was inferred by measuring Pb-214 and Bi-214. Ra-224 activity was inferred from Tl-208 acitivity. For this analysis, parent-daughter equilibrium for both the U-238 and Th-232 decay series was assumed. Sample activity was calculated by:

$$\text{Activity (pCi)} = \text{net counts/second} * 27.03 * \text{EFF}^{-1} * \text{ABD}^{-1}$$

Radionuclide concentrations (pCi/g) in the samples were determined by dividing the radionuclide activity by the sample mass. Sample analysis results are shown in Table 1.

Sample analysis results are listed with their associated counting errors (2 sigma). All samples with zero or negative net counts for a readionuclide have results for that nuclide listed as less than the appropriate minimum detectable concentration.

RESULTS:

All samples, with the exception of sample 2-W showed background levels of both U-238 and Th-232. Sample 2-W, which was collected 20 feet directly downstream of the STP discharge outlet, and elevated Th-232 (and daughter) concentrations of approximately 30 pCi/g. The U-232 and Ra-226 concentrations for this sample were at background levels.

TABLE 1

KERR MCGEE CHEMICAL CORPORATION
West Chicago, IL

DuPage River Soil Sediment
Radionuclide Analysis

R A D I O N U C L I D E C O N C E N T R A T I O N S (pCi/g)

| Sample No. | Mass (g) | U-238 | U-235 | Ra-226 | Th-232 | Ra-224 |
|------------|----------|----------------|-----------------|----------------|----------------|-----------------|
| 1E | 471 | 2.7 \pm 74% | < 0.93 | 0.58 \pm 46% | 0.74 \pm 69% | 0.55 \pm 74% |
| 1W | 400 | 3.8 \pm 73% | 0.72 \pm 130% | 1.6 \pm 26% | 1.3 \pm 46% | 1.3 \pm 49% |
| 2E | 391 | <2.8 | 1.2 \pm 83% | 1.3 \pm 33% | <0.77 | <0.42 |
| 2W | 329 | <3.3 | <1.3 | 1.7 \pm 50% | 28 \pm 9.5% | 33 \pm 7.4% |
| 3E | 459 | <2.4 | <0.95 | 0.47 \pm 68% | <0.66 | 0.68 \pm 46% |
| 3W | 405 | 3.3 \pm 80% | <1.1 | 1.3 \pm 29% | 1.3 \pm 48% | 1.8 \pm 29% |
| 4E | 432 | 2.5 \pm 100% | <1.0 | 0.78 \pm 40 | <0.70 | 0.47 \pm 100% |
| 4W | 423 | 2.7 \pm 100% | <1.0 | 1.6 \pm 27% | 2.0 \pm 32% | 1.2 \pm 50% |
| 5E | 406 | 2.5 \pm 100% | <1.1 | 0.69 \pm 37% | <0.75 | 0.56 \pm 100% |
| 5W | 416 | <2.6 | <1.1 | 1.5 \pm 24% | 1.3 \pm 46% | 0.47 \pm 110% |
| 6E | 434 | 2.4 \pm 93% | <1.0 | 0.75 \pm 49% | <0.70 | 0.84 \pm 49% |
| 6W | 372 | 2.7 \pm 110% | <1.3 | 1.9 \pm 25% | 3.3 \pm 28% | 2.7 \pm 26% |
| 7E | 344 | <3.2 | <1.3 | 0.95 \pm 41% | 1.7 \pm 40% | 0.94 \pm 54% |
| 7W | 356 | <3.1 | <1.2 | 2.0 \pm 22% | 1.1 \pm 62% | 1.0 \pm 60% |
| 8E | 396 | <2.8 | <1.1 | 0.86 \pm 38% | <0.76 | <0.42 |

TABLE 1 (cont.)
Page 2

RADIONUCLIDE CONCENTRATIONS (pCi/g)

| Sample No. | Mass (g) | U-238 | U-235 | Ra-226 | Th-232 | Ra-224 |
|-------------------------------|----------|----------------|---------------|----------------|----------------|----------------|
| 8W | 385 | 3.1 \pm 110% | 2.4 \pm 46% | 1.5 \pm 36% | 1.4 \pm 52% | 1.8 \pm 34% |
| 9E | 452 | 5.2 \pm 48% | <0.97 | 0.56 \pm 73% | 1.1 \pm 52% | 0.95 \pm 50% |
| 9W | 468 | 3.2 \pm 78% | <0.93 | 0.67 \pm 42 | <0.65 | <0.35 |
| 10E | 405 | <2.7 | <1.1 | 0.84 \pm 38% | 0.77 \pm 75% | 0.88 \pm 50% |
| 10W | 442 | 3.3 \pm 81% | <1.0 | 0.88 \pm 38% | <0.69 | 1.2 \pm 45% |
| 11E | 475 | 3.7 \pm 69% | <0.92 | 0.76 \pm 42% | 0.85 \pm 62% | 0.81 \pm 51% |
| 11W | 400 | 2.4 \pm 110% | 1.5 \pm 54% | 0.54 \pm 51% | <0.76 | 0.67 \pm 67% |
| 12E | 441 | 4.0 \pm 61% | <1.0 | 0.71 \pm 49% | 0.79 \pm 78 | 0.68 \pm 54% |
| 12W | 454 | 3.0 \pm 84% | <0.96 | 0.69 \pm 48% | 1.7 \pm 36% | 1.4 \pm 43% |
| 13E | 409 | <2.7 | <1.1 | 0.66 \pm 55% | 1.8 \pm 46% | 1.1 \pm 56% |
| 13W | 353 | <2.9 | <1.1 | 1.5 \pm 27% | 1.5 \pm 40% | <0.43 |
| 14E | 379 | 2.8 \pm 110% | <1.2 | 1.4 \pm 28% | 1.2 \pm 64% | 1.2 \pm 52% |
| 14W | 420 | <2.6 | <1.0 | 1.2 \pm 34 | 2.4 \pm 31% | 2.5 \pm 25% |
| 15E | 430 | <2.6 | <1.0 | 0.40 \pm 62% | <0.70 | 0.60 \pm 70% |
| 15W | 400 | 3.1 \pm 100% | 1.6 \pm 71% | 1.5 \pm 30% | 1.0 \pm 72% | 1.6 \pm 32% |
| BKG Sediment | 474 | <2.3 | <0.92 | 0.66 \pm 75% | 0.74 \pm 69% | 0.70 \pm 50% |
| Representative MDA's (pCi) | | 1097 | 437 | 96 | 303 | 165 |
| MDX's | 415 | 2.6 | 1.1 | 0.23 | 0.73 | 0.40 |

KERR McGEE CHEMICAL CORPORATION

DuPAGE RIVER SOIL SEDIMENT

RADIONUCLIDE ANALYSIS

APPENDIX A

GAMMA SPECTROSCOPY SYSTEM COMPONENTS

EG & G Ortec IG Detector Model GEM 10195-S SN 21-P-735C

Tracor Northern 1750 MCA SN 981136

Canberra Amplifier Model 2011 SN 481715

Ortec Bias Supply Model 459 SN 2223

| <u>SAMPLE I.D.</u> | <u>SAMPLE DEPTH</u> | <u>DISTANCE OFF SHORELINE</u> | <u>SAMPLE DESCRIPTION</u> |
|--------------------|---------------------|-------------------------------|---|
| <u>Background</u> | <u>0-8 inches</u> | <u>4 feet</u> | <u>Silty sand with organics, some gravel (carbonate sand and gravel with some shale and silicates); organic content high; dark gray-brown; no structures noticed</u> |
| <u>1-E</u> | <u>0-6 inches</u> | <u>5 feet</u> | <u>Silty sand with gravel (carbonate sand and gravel with some shale and silicates); organic content moderate; brown-gray color (dry)</u> |
| <u>1-W</u> | <u>0-4 inches</u> | <u>2-3 feet</u> | <u>Silty gravel with some sand (carbonate sand and gravel with some shale and silicates); organic content moderate; medium gray color (dry)</u> |
| <u>2-E</u> | <u>0-6 inches</u> | <u>2 feet</u> | <u>Silty gravel with some sand (carbonate sand and gravel with a little silicate sand and shale); organic content moderate to low; light brown-gray color (dry)</u> |
| <u>2-W</u> | <u>0-4 inches</u> | <u>3-4 feet</u> | <u>Light brown colored layers of silt and fine sand (1/2-1" thick) banded with a dark gray, highly organic silty muck; some fine sand found; true compositions unknown; sandy gravel below 4 inches</u> |
| <u>3-E</u> | <u>0-6 inches</u> | <u>2-3 feet</u> | <u>Sandy gravel with some silt (carbonate sand and gravel, some silicate and shell fragment sand, rare shale); organic content moderate to low; gray-brown color (dry)</u> |
| <u>3-W</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Sandy gravel with underlying soily muck at 4" (carbonate gravel and sand, some silicates and rare shale); organic content moderate to low; gray-brown color (dry)</u> |

| <u>SAMPLE I.D.</u> | <u>SAMPLE DEPTH</u> | <u>DISTANCE OFF SHORELINE</u> | <u>SAMPLE DESCRIPTION</u> |
|--------------------|---------------------|-------------------------------|---|
| <u>4-E</u> | <u>0-6 inches</u> | <u>2 feet</u> | <u>Gravel with underlying gravelly sand, some silt</u> <u>and plant organics (carbonate sand and gravel,</u> <u>some silicates and rare shale); organic content</u> <u>moderate to low; light brown-gray color (dry)</u> |
| <u>4-W</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>2-3" of highly organic silty muck with underlying</u> <u>gravelly sand and silt (carbonate gravel and</u> <u>sand); organic content high; gray brown color</u> <u>(dry)</u> |
| <u>5-E</u> | <u>0-4 inches</u> | <u>3 feet</u> | <u>Gravelly sand with silt, abundant cobble and</u> <u>boulder (carbonate sand and gravel, rare shale,</u> <u>and silicate sand); organic content moderate to</u> <u>high; light brown-gray color (dry)</u> |
| <u>5-W</u> | <u>0-8 inches</u> | <u>10 feet (on sandbar)</u> | <u>Gravelly sand with little silt (carbonate gravel</u> <u>and sand); organic content moderate; light</u> <u>brown-yellow color (dry)</u> <u>Sample taken from sandbar near city sewer outlet.</u> |
| <u>6-E</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Silty sand with little gravel (carbonate and</u> <u>silicious sand); becomes soily beyond 6" and</u> <u>contains many lilly pad roots; organic content</u> <u>high; medium brown-gray color (dry)</u> |
| <u>6-W</u> | <u>0-9 inches</u> | <u>4 feet</u> | <u>Sandy silt with some gravel and clay (carbonate</u> <u>gravel and sand, some silicious sand); increas-</u> <u>ingly sandy downward; organic content very high;</u> <u>light greenish brown-gray color (dry)</u> |
| <u>7-E</u> | <u>0-6 inches</u> | <u>2-3 feet</u> | <u>Gravelly silt with some sand (carbonate gravel</u> <u>and sand); sand and gravel increases downward;</u> <u>organic content high; dark gray-brown color</u> <u>(dry)</u> |

| <u>SAMPLE I.D.</u> | <u>SAMPLE DEPTH</u> | <u>DISTANCE OFF SHORELINE</u> | <u>SAMPLE DESCRIPTION</u> |
|--------------------|---------------------|-------------------------------|--|
| <u>7-W</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Gravelly silt with little sand (carbonate gravel and sand); sand and gravel increases downward; organic content moderate; medium gray-brown color (dry)</u> |
| <u>8-E</u> | <u>0-4 inches</u> | <u>2 feet</u> | <u>Sandy gravel with some silt (carbonate gravel and sand, some silicious sand); organic content moderate; light brown-gray color (dry)</u> |
| <u>8-W</u> | <u>0-12 inches</u> | <u>5 feet</u> | <u>Gravelly silt with sand (carbonate gravel and sand, some silicious sand); sand increases downward, silty muck towards top; moderate to high organic content; dark gray color (dry)</u> |
| <u>9-E</u> | <u>0-6 inches</u> | <u>2-3 feet</u> | <u>Sandy gravel with silt (carbonate gravel and sand); organic content low; light brown-gray color (dry); rapid water current and lack of true sediment - this may be exposed ancient sediment/till.</u> |
| <u>9-W</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Same description as in 9-E; material on river bed is similar to till-like material exposed on the shoreline (below a dark organic soil and vegetation).</u> |
| <u>10-E</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Silty sand with some fine gravel - coarsens downward, organic muck on top (carbonate sand and gravel); organic content moderate to high; dark gray-brown color; sample from apex of river bend.</u> |
| <u>10-W</u> | <u>0-9 inches</u> | <u>2 feet</u> | <u>Same description as 10-E; sediment is deeper and a little more organic, due to location of sampling (inside curve of river bend/ shallow mudbar)</u> |

| <u>SAMPLE I.D.</u> | <u>SAMPLE DEPTH</u> | <u>DISTANCE OFF SHORELINE</u> | <u>SAMPLE DESCRIPTION</u> |
|--------------------|---------------------|-------------------------------|--|
| <u>11-E</u> | <u>0-9 inches</u> | <u>2 feet</u> | <u>Sandy gravel grading to gravelly sand (mostly</u> <u>carbonate gravel and sand); only a little silts,</u> <u>finer, and organics present due to fast current</u> <u>of water; possibly ancient sediment or till</u> |
| <u>11-W</u> | <u>0-6 inches</u> | <u>2 feet</u> | <u>Similar description as 11-E; a little more</u> <u>organic towards top; brown-gray color (dry);</u> <u></u> <u></u> |
| <u>12-E</u> | <u>0-9 inches</u> | <u>2 feet</u> | <u>Sandy & silty gravel topped by silty organic muck</u> <u>(carbonate sand and gravel); some cobble present;</u> <u>organic content high at top, less downward;</u> <u>dark to medium brown-gray color (dry)</u> |
| <u>12-W</u> | <u>0-9 inches</u> | <u>10 feet</u> | <u>Gravelly silty sand topped by silty organic muck</u> <u>(carbonate sand and gravel); some cobble present;</u> <u>organic content high at top, less downward;</u> <u>dark to medium brown-gray color (dry)</u> |
| <u>13-E</u> | <u>0-7 inches</u> | <u>3 feet</u> | <u>Sandy silt with gravel topped by silty organic</u> <u>muck (carbonate sand and gravel); highly organic</u> <u>at top, coarsening and becoming less organic</u> <u>downward; gray color (dry); "quiet"water area</u> |
| <u>13-W</u> | <u>0-6 inches</u> | <u>3 feet</u> | <u>Gravel to gravelly sand topped by 1" of silty</u> <u>organic muck (gravel and sand is carbonate);</u> <u>coarsens below 6"; highly organic at top, much</u> <u>less organic below top 2"; brown-gray color (dry)</u> |
| <u>14-E</u> | <u>0-9 inches</u> | <u>2 feet</u> | <u>2"-3" of organic muck over a gravelly silty sand</u> <u>(carbonate sand and gravel); highly organic at</u> <u>top, less organic downward; coarsens below 9";</u> <u>dark gray to black; sample taken near lilly pads</u> |

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DOCKET NO. 40-2061
CONTROL NO. 25875
DATE OF DOC. 07/19/85
DATE RCVD. 10/09/85
FCUF ☒ FDR ☒
FCAP ☐ LPDR ☒
WM ☐ I&E REF. ☒
WMUR ☐ SAFEGUARDS ☐
FCTC ☐ OTHER ☐

DESCRIPTION:

final report
containing the
methodology for
sample collection
analysis and the results
10/10/85 INITIAL DEC