Through Partners of Scott County Watersheds (PSCW) and Iowa DNR IOWATER Program, a water quality database has been created for streams and lakes in Scott County, Iowa. Data has been collected semiannually since October 2000 in the fall and spring. Parameters analyzed include transparency, water/air temperature, concentrations of dissolved oxygen, nitrate, nitrite, phosphorus (as orthophosphate), chloride, and pH. Up until 2014 samples were collected by volunteers for subsequent analysis of *Escherichia coli* (*E. coli*) at the State of Iowa Hygienic Lab. The PSCW Scott County water quality database (Database) represents 239 sample locations distributed throughout the County. The Database has almost 2000 *E. coli* analyses, as well as over 2300 individual results each for parameters listed above.

The Database was screened to determine which sample locations had a minimum of ten years of continuous data. The ten year threshold was utilized to ensure that various climatic and flow regimes were represented, and to better determine trends. 55 sample locations met the ten year threshold.

The Matrix was developed using parameter trends, and comparing mean values against water quality reference values. Trends were determined by calculation of the slope of the trend line, with a positive slope indicating an 'Up' trend, a negative slope indicating a 'Down' trend, and very small value slopes (positive or negative) indicating a 'Stable' trend. For nitrate, nitrite, phosphorus, and chloride, an 'Up' trend represented an increasing concentration over time and therefore not desirable from a water quality standpoint, while a 'Down' trend was the opposite. For transparency and dissolved oxygen a 'Down' trend represented a decreasing concentration over time and therefore not desirable from a water quality standpoint, while an 'Up' trend represented the opposite. Since desirable pH values are a range of 6-9, an 'Up' trend represented an increasing value over time and therefore not desirable from a water quality standpoint, and a 'Down' trend was the opposite but still represented a non-desirable condition. For pH a 'Stable' trend was utilized as optimum.

A determination was made if a parameter was a concern for the stream sample location. Determinations were made using the following guidelines:

- Red trend, red mean = parameter a high concern
- Red trend, yellow mean =parameter a concern
- Red trend, green mean = parameter not a concern depending on parameter magnitude
- Yellow trend, red mean = parameter a high concern
- Yellow trend, yellow mean = parameter a concern
- Yellow trend, green mean = parameter not a concern
- Green trend, red mean= parameter a high concern
- Green trend, yellow mean = parameter not a concern depending on parameter magnitude
- Green trend, green mean = parameter not a concern

Findings:

- Apparent that nutrients (nitrate/nitrite and phosphorus) are of concern for rural, suburban and urban areas of Scott County.
- Transparency, essentially water clarity, appears to be a more rural concern and somewhat a suburban concern.
- Dissolved oxygen and chloride are a suburban and urban concern.
- The only parameter with no concerns in pH.

It should be noted that general stereotypical concerns about a geographic setting, such that nutrients are only a rural concern, or chloride is only an urban concern, are not founded. There are streams within each geographic setting that defy conventional wisdoms.

Analysis of the Matrix also reveals general county-wide trends for the parameters:

- Trends for nitrite and phosphorus are predominately 'Up' or 'Stable' above a desired reference level, therefore not in a desirable trend pattern for many locations across Scott County.
- Nitrate and pH appear to be exhibiting desirable trends when combined with mean concentration data.
- Transparency and Dissolved Oxygen are predominately trending 'Down' or 'Stable', a non-desirable trend pattern, although the number of nondesirable trends with a corresponding mean above a reference level are relatively few.
- Chloride trends are predominately 'Up' or 'Stable', but areas of concern are not as widespread as with nutrients.

A PDF of the PowerPoint presentation about the Database and Matrix is located here: http://partnersofscottcountywatersheds.org/wp-content/uploads/2018/07/Partners-of-Scott-County-Watersheds-7-17-18.pdf

In 2008 the US EPA report Nitrate and Phosphorus in Agricultural Watersheds (2008) indicated reference levels for ecological effects of these two nutrients. The reference levels are not enforceable water quality standards, just thresholds for comparisons. The reference levels varied by ecoregion due to how dependent the ecological effects are on hydrology, water body size, climate, etc. For nitrogen, the report suggested an appropriate reference level range in streams of 0.12 to 2.2 mg/L total nitrogen. The phosphorus analyses in the report suggested appropriate reference levels that range from 0.01 to 0.075 mg/L total phosphorus.

The IOWATER program provides technical resources (2018) for assessment of parameter values that include data interpretation methods. "Levels of concern" were specified for use with volunteer acquired data to immediately recognize a probable abnormal condition. Thus, IOWATER levels of concern are as follows; nitrite > 0.3 mg/L, nitrate: > 20 mg/L, phosphorus > 0.6 mg/L, dissolved oxygen < 5 mg/L, pH < 6 and chloride > 100 mg/L.

In Iowa, there is no surface water quality standard for nitrate beyond the drinking water standard of 10 mg/L (2012), and determination of a standard for degradation of a water body other than for drinking water is not technically feasible at this time. Nitrate is a subset of total nitrogen, and because the Database measurements for nitrogen are in nitrate and nitrite, the US EPA reference levels suggested for total nitrogen can't be utilized directly. However, given that 1 mg/L is detectible using IOWATER sample methodology, and that 1 mg/L is the midpoint of the US EPA suggested reference level range, the 1 mg/L value was utilized as a reference level for ecological effects for nitrate. Therefore, for the purposes of the Matrix, a trend of 'Up', or a 'Stable' trend with a mean concentration greater than 1 mg/L were classified as not desirable and color coded accordingly in the Matrix. Section 3.2 details the Matrix color coding system. The IOWATER program reference level of 20 mg/L was used a secondary reference level to identify locations that qualify for a higher level of concern.

As with nitrate, there is no surface water quality standard for nitrite except for the drinking water standard of 1 mg/L. The same determinations for nitrate mentioned above are applicable to nitrate

reference levels. Given that 0.15 mg/L is detectible using IOWATER sample methodology, and is within the US EPA suggested total nitrogen reference level range, 0.15 mg/L was utilized as a reference level for ecological effects for nitrite. Therefore, for the purposes of the Matrix, a trend of 'Up', or a 'Stable' trend with a mean concentration greater than 0.15 mg/L were classified as a non-desirable trend and color coded accordingly. The IOWATER program reference level of 0.3 mg/L was used a secondary reference level to identify locations that qualify for a higher level of concern.

In 1986 the US EPA recommended a low reference level of 0.1 mg/L (total phosphorus) related to nuisance algae growth in rivers and streams. As mentioned above, in 2008 a US EPA report suggested ecological effects reference levels in a range 0.01 to 0.075 mg/L for total phosphorus. The Database concentrations are predominately measured as orthophosphate, a subset of total phosphorus. Therefore, any Database orthophosphate concentration greater than or equal to 0.1 mg/L automatically would exceed the 0.01 to 0.75 mg/L and 0.1 mg/L total phosphorous reference levels. In Iowa, there are no surface water quality standards for total phosphorus or orthophosphate and generation of a standard is not technically feasible at this time. Therefore, for the purposes of the Matrix, a trend of 'Up' or a 'Stable' trend with a mean concentration greater than 0.1 mg/L were classified as non-desirable and color coded accordingly. The IOWATER program reference level of 0.6 mg/L was used a secondary reference level to identify locations that qualify for a higher level of concern.

For transparency, no water quality standard exists in Iowa. However, a related parameter, turbidity, does have a surface water quality standard of 25 nephelometric turbidity units (NTU) [a discharge cannot increase the turbidity of the receiving water body by more than 25 NTU (2012)]. Utilizing a University of Wisconsin conversion method (2003), 25 NTU approximately equates to 30 cm of water clarity using a Secchi tube for transparency measurement. The conversion utilizes an inverse relationship, as the NTU value increases, the corresponding transparency value decreases. A transparency reading of 30 cm or lower in a Secchi tube indicates that the turbidity would be above 25 NTU. It is inferred that a NTU of 25 or higher is detrimental to aquatic habitat. While not a perfect correlation, the 30 cm value does allow for determination if a sample location transparency could be considered low enough to classify as a concern. Therefore, a trend of 'Down', or a 'Stable' trend with a mean transparency of less than 30 cm were classified as non-desirable and color coded accordingly in the Matrix. The Minnesota Pollution Control Agency (2005) developed a more conservative conversion of transparency to NTU in which a transparency value of less than 20 cm exceeds 25 NTU. Therefore, for the purposes of the Matrix, a transparency mean of 20 cm was used a secondary reference level to identify locations that qualify for a higher level of concern.

A surface water quality standard is in place for dissolved oxygen concentrations. A dissolved oxygen concentration of 5 mg/L or above is considered adequate for the protection of aquatic life (2012). Since a standard exists, the 5 mg/L value was used a secondary reference level to identify locations that qualify for a higher level of concern. For the purposes of the Matrix, a trend of 'Down', or 'Stable' with a mean of less than 8 mg/L was classified as non-desirable and color coded accordingly.

Chloride has two surface water quality standards, one for chronic exposure and one for acute exposure (2012). The default acute and chronic water quality standards for chloride are 629 mg/L and 389 mg/L respectively. Acute refers to a brief exposure which rapidly induces an effect. Chronic refers to an exposure that occurs over a long time period, and induces effects that develop only after a long exposure. These standards are a function of the total hardness (as CaCO3) and sulfate concentrations in a water body. The default standards use an assumed concentration of 200 mg/L for total hardness and 63 mg/L for sulfate. IOWATER guidance materials indicate concentrations over 100 mg/L for chloride are

cause for concern. For the purposes of the Matrix, a trend of 'Up' or 'Stable' with a mean greater than 100 mg/L were classified as non-desirable and color coded accordingly.

Iowa has established a range of values for pH for Class A, Class B and Class C waters (2012. This range for the support of aquatic life is 6.5 to 9. For the purposes of the Matrix, a trend of 'Up' or 'Down' and a mean less than 7 or greater than 8 were classified as non-desirable and color coded accordingly. The IOWATER program reference level of a pH value of less than or equal to 6 was used a secondary reference level to identify locations that qualify for a higher level of concern.

Geometric means of *E. coli* concentrations for each sample location are included in the Matrix for reference.