State of Ohio
Environmental Protection Agency

Wetland Ecology Group
Division of Surface Water

THE VEGETATION INDEX OF BIOTIC INTEGRITY "FLORISTIC QUALITY" (VIBI-FQ)

Ohio EPA Technical Report WET/2013-2






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Brian Gara

ABSTRACT

The Vegetation Index of Biotic Integrity "Floristic Quality" (VIBI-FQ) was developed as an enhancement to the existing Vegetation Index of Biotic Integrity (VIBI) protocols (Mack, 2007b) for Ohio. The VIBI-FQ represents a streamlined version of the VIBI which reduces the amount of field data necessary for the assessment and also simplifies the calculation and interpretation of a final score. It is based exclusively on the principle of species sensitivity as defined in the *Floristic Quality Assessment Index (FQAI) for Vascular Plants and Mosses for the State of Ohio* (Andreas, et. al., 2004). Only two metrics are used to calculate an overall score, and these focus on the critical ecosystem elements of diversity and dominance as they relate to species' "coefficient of conservatism" (CofC) values.

The key ingredients to this method are: 1) the existence of habitat sensitivity (CofC) values that have been assigned to all species within that group for a given geographic range, such as a state or ecoregion, and 2) appropriate field protocols for measuring both presence and abundance of individuals within that taxonomic group. In Ohio, the *Floristic Quality Assessment Index (FQAI) for Vascular Plants and Mosses for the State of Ohio* (Andreas, et. al., 2004) contains CofC values for each vascular plant species known to occur in the state. Additionally, the traditional VIBI documentation (Mack, 2007b) provides a comprehensive methodology for collecting all necessary vegetation data required for the calculation of a VIBI-FQ score.

In order to verify consistency with earlier field assessments, a VIBI-FQ score was back-calculated for a total of 300 wetlands previously assessed using standard monitoring techniques by the Ohio EPA Wetland Ecology Group. A strong statistical correlation was found between the streamlined VIBI-FQ scores and those generated using the more traditional VIBI methodology. Comparing VIBI-FQ scores with ORAM scores for a subset of 278 wetlands yielded similar results.

The primary goal of this work is to provide additional opportunities for improved monitoring of the development of wetland ecosystems during the early stages of plant succession. It must be emphasized that existing VIBI procedures, thoroughly documented in the document entitled *Integrated Wetland Assessment Program. Part 9: Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.4* (Mack, 2007b) represent the preferred methodology for assessing wetland condition within the context of the Ohio EPA's 401 and Isolated Wetland permit programs. The VIBI-FQ is proposed to be a substitute tool for monitoring site development in wetland restoration projects, including mitigation sites, within Ohio. It is also expected that VIBI-FQ monitoring will be a valuable tool for comparing the ecological condition of non-wetland plant communities with one another.

INTRODUCTION

The VIBI was developed by the Ohio EPA Wetland Ecology Group (WEG) over a period of many years. This process involved a detailed analysis of several hundred natural wetlands located throughout the state (Mack, et. al., 2000; Mack, 2001b; Mack, 2004; Mack, 2007a; Mack, 2007b). The VIBI has been in use as an integral part of the Ohio EPA wetland regulatory program for close to 10 years, and a wealth of VIBI data exists on literally hundreds of natural and mitigation wetlands located throughout Ohio.

The WEG has developed a modified version of the VIBI that focuses exclusively on the principles elaborated in the FQAI. In this system, species typically found in disturbed and/or early successional sites have low coefficient of conservatism [CofC] scores, whereas those species generally present only within undisturbed, "climax" communities have much higher CofC scores (Andreas, et. al., 2004). This updated VIBI, or VIBI-"Floristic Quality" (VIBI-FQ) builds on the considerable data recorded by the WEG during the course of hundreds of vegetation surveys conducted on natural wetlands over the last 10+ years. This update is not intended to supersede the previous versions of the VIBI (Mack, 2007b), but rather to expand the use of the procedure to other habitats and situations. Additionally, the updated VIBI addresses some of the limitations encountered through the implementation of the traditional VIBI protocols.

The VIBI-FQ focuses on two elements of the plant community: diversity and dominance. Understanding the relationship of these two basic factors relative to other similar plant communities in Ohio provides information as to whether a particular habitat should be considered to be in "reference condition." Reference habitats, in the context of this procedure, are defined as being in pristine condition, essentially devoid of any significant human disturbance.

VIBI-FQ MONITORING PROTOCOLS

The field protocols required to collect the data required to calculate a VIBI-FQ score is virtually identical to the standard vegetation monitoring used for standard VIBI assessments. Detailed instructions for conducting the vegetation survey can be found in the following Ohio EPA VIBI document:

http://www.epa.ohio.gov/portals/35/wetlands/Part9_field_manual_v1_4rev4sept07.pdf.

A summary of this protocol is as follows: A typical focus plot measuring 20 meters by 50 meters is constructed within the plant community being assessed. This plot should be placed to capture the portion of the wetland that contains the highest diversity. Four "intensive modules" within this plot are evaluated to record all species present with a cover class being assigned to each. The remaining six "residual" modules are then surveyed, with any new species not yet encountered in any intensive modules recorded. A cover class is assigned based on a visual estimate of the proportion of the residual area covered by each species. These

data are recorded on Field Datasheet 1 (Mack, 2007b). Unlike the standard VIBI protocols, however, cover class values are assigned to all species overhanging any of the modules, including woody species greater than 6 meters in height. No woody stem data are recorded, so Field Data Sheet 2 is not required. Also, the biomass metric is not used in the VIBI-FQ, so no clip plot data are collected.

CALCULATING A VIBI-FQ SCORE

The VIBI-FQ focuses on two elements of the plant community: diversity and dominance. These factors are represented by two metrics which are equally weighted with a maximum value of 50 points each. Therefore, possible scores for the VIBI-FQ range from 0 to 100.

Metric 1: Diversity

The first metric is the Floristic Quality Assessment Index (FQAI), which is included as one of the metrics in all other versions of the VIBI used to date (VIBI-emergent, VIBI-forest, and VIBI-shrub) (Mack, 2007b). This procedure is a well-established diversity index that has been in use throughout the United States for over 20 years. In the FQAI, each plant species is assigned a "coefficient of conservatism," or "C of C" score between 0 and 10. These scores are based on the affinity each species has to a particular habitat. Lower C of C scores are indicative of species tolerant to areas of substantial disturbance and found in a wide variety of habitats. Conversely, high scores are reserved for more sensitive species – those intolerant of disturbance and which are typically found in specific ecosystem niches. The general assumption is that undisturbed, "climax" plant communities will be composed mostly of more sensitive species, while early successional communities will be dominated by highly tolerant species. This principle allows this procedure to be used for evaluating the progress of a rapidly developing ecosystem, such as a wetland restoration site or a riparian corridor planting.

The FQAI is calculated by summing the C of C values for all species identified within a specific survey area and dividing by the square root of the total number of species (Andreas, et. al., 2004). For a VIBI, the sample area is typically a 20 meter by 50 meter plot, divided into 10 equal modules. All species within the 0.1 hectare area recorded.

Metric 1 is generated by first calculating the standard FQAI score for the species list recorded within the VIBI sampling plot. In considering how to develop an appropriate metric score for the FQAI diversity index, 300 natural wetlands that had previously been monitored by the WEG were evaluated. Figure 1 is a histogram showing the range of FQAI values calculated for each of these wetlands.

As it is readily apparent that a vast majority of FQAI scores fall within 10 to 30, with very few plant communities scoring beyond these values, it was decided to use this range when calculating the metric score. In order to give equal weight to both the diversity and dominance metrics in the updated VIBI,

each was determined to have a maximum total value of 50. This also ensures that the total range of values was between 0 and 100, conforming to the previous VIBI calculations. This also establishes an easy to interpret scale, where 0 represent the most degraded sites and 100 would be reserved for habitats in true reference condition. The diversity metric calculation would therefore be:

((FQAI-10)/20)*50

Sites with an FQAI score less than 10, and therefore, having a negative metric value are simply assigned to "0" and all sites scoring above 50 (i.e., having an FQAI value greater than 30) likewise are truncated to exactly 50. Once additional upland habitat types are included in the analysis, the FQAI distribution may dictate a modification of the calculation slightly (e.g., instead of 10 - 30, the range may be changed to 5 - 40).

Comparing the diversity metric to total VIBI scores for each of the 300 natural wetlands shows a strong statistical relationship. Figure 2 is a scatterplot of this metric vs. the traditional VIBI calculation, with a superimposed regression line.

Metric 2: Dominance

One of the limitations of using the FQAI as a standalone metric is the fact that it *only* considers the overall diversity of the site. Each species is given equal weight, regardless of the dominance of these species within the sampled plant community. Dominance can be recorded in various ways, but with the traditional VIBI protocols, species cover, is the method used to establish which species represent the most biomass and therefore are "dominating" the plant community. This metric is meant to establish the sensitivity of those dominants within the vegetation. Using the same 20M x 50M VIBI sample plot described above, all species recorded within 4 "intensive" modules are assigned a cover class value as follows:

1 = solitary/few
2 = 0-1%
3 = 1-2%
4 = 2-5%
5 = 5-10%
6 = 10-25%
7 = 25-50%
8 = 50-75%
9 = 75-95%
10 = 95-99%

The four intensive modules should be centered on the areas of the overall plot which exhibit the highest overall diversity. Any additional species encountered in the remaining six "residual" modules are also recorded and assigned a cover class code based on the total cover each represents for the entire area of these six residual modules. In the traditional VIBI assessment, only plants less than 6 meters in height are assigned a cover class. In this procedure, however, all plant species, regardless of height, should be assigned to one of the aforementioned cover classes. This allows for a reduction in overall sampling effort, as measuring stem DBHs for all woody specimens over one meter in height (as is required for the traditional VIBI) will not be necessary. A total cover value is calculated for a site by converting the cover classes to the midpoint cover value for the class,

summing all of the cover values for each species recorded within all plots, and summing the total cover for all species. A relative cover is then assigned to each species by dividing the total plot cover of each by the total cover for all species. In order to determine the sensitivity of dominant species, relative cover values for each species are then multiplied by its C of C value. Summing all of these values for all species creates a single "cover-weighted" C of C score for the sample area, with values ranging from 0 to 10. Since individual species with a C of C value of 6 or above are considered to be sensitive, and indicative of climax communities, the "cover-weighted" was also interpreted in this manner. The site dominance metric score can also range from 0 to 50 and is calculated as follows:

(("cover-weighted" C of C)/6)*50

As with the diversity metric, all dominance values scoring above 50 are truncated to exactly 50. Once again, when comparing traditional VIBI scores to this dominance metric shows a solid statistical relationship (Figure 3).

Summing metric 1 (diversity) and metric 2 (dominance) establishes a total VIBI-FQ score between 0 and 100 using this simplified approach.

EXAMPLE CALCULATION

As an effort to help learn the new VIBI-FQ procedure, an example is being included as a step-by-step guide to performing all steps in the process. The example site is based on actual vegetation data collected as part of the Ohio EPA Wetland Ecology Group's monitoring program.

A 20 meter by 50 meter VIBI plot is established and all plant species are identified and assigned a cover class value as per the VIBI field protocols (Mack, 2007b). Table 1 displays the raw field data collected for the site, including all species identified, and cover class values assigned to each for the 4 intensive and 6 residual 10 meter by 10 meter modules. These cover class values were then converted to cover class midpoints for each species (Table 2).

The calculations for the two VIBI-FQ metrics are as follows:

- Diversity (FQAI) – the sum of all CofC values for the species list recorded within this 20 meter by 50 meter vegetation plot (27) is divided by the square root of the total number of species (12) (Andreas, et.al., 2004):

  $$FQAI = 27 \div \sqrt{12}$$

  $$FQAI = 7.8$$

  The final metric score for diversity is obtained by subtracting 10 from the raw FQAI score and dividing by 20:

  $$FQAI_{metric} = ((7.8\text{-}10) \div 20) \times 50$$

  $$\mathbf{FQAI_{metric} = -5.5}$$

  Since the score is less than zero, (indicating a raw FQAI value less

than 10), the FQAI metric score receives 0 points.

- Dominance ("Weighted CofC") – The cover class midpoint values is summed for each species to generate a "total species cover" value, then summed for the entire site (Table 2). In this example, the total cover for all species recorded in the veg plot is 6.8752.
    - The total species cover value is then divided by the total plot cover value (6.8752) to obtain the "species relative cover" value.
    - Species relative cover values are then multiplied with the assigned CofC value for each species to generate the "species cover weighted CofC" score.
    - Summing all of these individual species values calculates the raw "cover weighted CofC" score for the site, which in this case is 2.762131.
    - The dominance metric is calculated by dividing the cover weighted CofC by 6 and multiplying by 50.

$$\text{Weighted CofC}_{\text{metric}} = (2.762131 \div 6) \times 50$$

Weighted $\text{CofC}_{\text{metric}}$ = 23.02

- The final VIBI-FQ calculation is accomplished by adding the two individual metric scores:

$$\text{VIBI-FQ} = \text{FQAI}_{\text{metric}} + \text{Weighted CofC}_{\text{metric}}$$

$$\text{VIBI-FQ} = 0 + 23.02$$

VIBI-FQ = 23.02

COMPARISON OF VIBI-FQ WITH TRADITIONAL VIBI AND ORAM SCORES

VIBI-FQ data for all natural wetlands included in this report are shown on Table 3. Comparing the total score for each of the 300 natural wetlands with the overall VIBI score previously calculated for these site shows a very strong statistical relationship (Figure 4). A boxplot comparing updated VIBI-FQ scores with the antidegradation category established using the traditional VIBI calculation shows an equally strong relationship (Figure 5).

A similar analysis was conducted for all sites in which both a VIBI and an Ohio Rapid Assessment Method for Wetlands (ORAM) had been conducted by the WEG. The ORAM is a rapid procedure which assesses wetland condition based on field observation of several factors, including size, amount of protective buffer, intensity of surrounding land use, and several habitat features. A boxplot comparing VIBI-FQ scores with the ORAM antidegradation category (Figure 6) shows a very similar relationship to Figure 5.

As a final test of this procedure, a comparison was made between the "best of the best" and the "worst of the worst" for all sites previously monitored by the WEG. For the 300 sites in which a VIBI-FQ score was back-calculated, a total of 53 sites had a score greater than 80. All of these sites were assessed as Category 3 wetlands using the traditional VIBI calculation. Conversely, 37 sites had VIBI-FQ scores less than 20, and of these, 27, or ~73%, scored as Category 1 wetlands with the traditional VIBI procedure. The remaining 10 sites scored as Category 2. While not a perfect relationship, the fact that the very best sites are being identified consistently by both procedures is reassuring.

USE OF VIBI-FQ TO MONITOR MITIGATION WETLANDS

The traditional VIBI will be the recommended procedure when assessing wetland condition for 401 and isolated wetland permit decisions. However, in order to use the VIBI-FQ for monitoring mitigation sites, a breakpoint approximating a mid-range Category 2 wetland is necessary. This would allow for a performance standard to be established for wetland restoration and creation projects that could be achieved over a typical 5 to 10 year monitoring period.

A number of mitigation sites in which one of more traditional VIBIs had been conducted were included in this analysis. These sites included mitigation banks and permittee-responsible mitigation wetlands (Table 4). Only sites that had specific VIBI numeric performance goals have been included. VIBI and VIBI-FQ scores were plotted against monitoring year to determine if there was a trend in scoring as a site progressed from bare ground to functioning plant community through the entire monitoring period. As most of the sites requiring VIBI as a performance standard have been established recently, the graphs only contain monitoring data for years one through five. As these sites progress and more monitoring data becomes available, it is the intention of the WEG to continually update this information to better understand the mechanisms of plant community development associated with wetland restoration and creation projects. Figure 7 illustrates the pattern of traditional VIBI scores over a 5-year monitoring period. Figure 8 displays VIBI-F scores over the same monitoring period. In general, scores are low the first two years of monitoring before increasing during years three, four, and five. While the patterns seem to be similar, there also appears to be more "noise" associated with the traditional VIBI scores. Interpretation of VIBI-FQ scores is more straightforward, as the expected response of the two metrics is fairly intuitive. As a site matures, diversity levels increase and a larger proportion of the plant community should become increasingly dominated by species typical of more stable ecosystems (i.e., higher C of C scores). If the response of a particular site is not trending in the positive direction for these two metrics over the course of a monitoring period, this would be an indication that some sort of disturbance is retarding the development and remedial action may be required.

The pattern is similar for the traditional VIBI scores, as the same species diversity and sensitivity concepts are included in several of the included 10 metrics. However, misinterpretation of habitat type (e.g., upland vs. wetland, HGM class, plant community type) could add error to the analysis in some instances. Additionally, several traditional VIBI metrics may not respond rapidly enough to clearly indicate whether or not a site is developing as desired early in the successional process.

It also appears that scores generated using the traditional VIBI methodology may be artificially higher on mitigation projects than those for the VIBI-FQ. For the dataset of natural wetlands (N=300), the mean VIBI score is 56.0 whereas the mean score for the VIBI-FQ is 52.0. In comparing these scores on a site by site basis, in 58.7% of these natural wetlands, the traditional VIBI score is higher than the score generated by the VIBI-FQ (176 out of 300). In the mitigation dataset, the mean VIBI score was 49.4, and the mean VIBI-FQ score was 34.8. For these restored/created wetlands, the VIBI score was higher 86.7% of the time (130 out of 150). This discrepancy may be due to the ambiguity associated with setting up the sampling plot correctly, especially in cases where plots contain a mixture of wetland and upland habitat. In these instances, crossing plant community boundaries within VIBI plots may be artificially inflating specific metric scores. This factor is much more critical for the traditional VIBI than the VIBI-FQ.

Using VIBI-FQ performance goals in lieu of traditional VIBI scores may help to alleviate some of these problems. The WEG intends to continue building a database of wetland mitigation project monitoring data to see if patterns described in this report are confirmed or if the vegetation monitoring procedures need to be modified as more data becomes available.

Based on these preliminary data, it appears that a trend in plant community development can be illustrated over the course of a typical monitoring period, which will help to establish appropriate expectations for site performance goals. Given that only five years of monitoring data are included, the preliminary recommendation for a VIBI-FQ performance goal would be a score of 45 by the end of the monitoring period. This is based on statistical mean of VIBI-FQ scores calculated for both natural wetlands (Mean= 52.0; N=300) and mitigation sites in at least the 4th year of monitoring (Mean=50.4). A score of 45 provides a 5-point "safety net" to ensure the likelihood of achieving this score within a monitoring period, which may not be long enough for the plant community to reach full maturity. Achieving this score would be an indication that the plant community is developing into a mid-range Category 2 wetland as desired. As more data is generated for sites further along in the development process, this value may be modified somewhat. In the rare instances when Category 3 mitigation is required, a comparison of VIBI-FQ scores with those calculated using the traditional VIBI approach suggests that an approximate VIBI-FQ target score should be 55. This is estimated by taking the mean VIBI-FQ score for sites scoring as Category 3 using the

traditional VIBI (~72) and subtracting one standard deviation (~17).

It is not anticipated that ecoregional differences will affect these scoring ranges as the principles of habitat sensitivity, as defined by the coefficient of conservatism scores assigned to each species, should apply regardless of local environmental variations. As more VIBI-FQ data is collected on additional studies, this concept will be examined more closely to determine if scoring ranges need to be re-evaluated based on these ecoregion boundaries.

CONCLUSIONS

The VIBI-FQ procedure is a simplification of previous VIBI assessment techniques used in Ohio for over 10 years. It captures most of the information necessary to establish an overall habitat condition score that is very closely correlated to the traditional methodology. It reduces the overall work required and enhances the potential utility of conducting a VIBI in a number of specific ways:

1) Only species presence and cover is recorded from each 20M x 50M sample plot. This eliminates the need for the measurement of woody stem DBHs (field data sheet 2 from the traditional method). It also eliminates the need for clip plot data. Information recorded on the physical parameters sheet remains a recommended, but optional procedure. These data provide valuable background data on the site, but do not play a role in VIBI score calculation in either the traditional or updated approach.

2) The updated VIBI calculation is valid in any plant community type, upland or wetland. Additionally, no decision must be made as to the proper classification of the habitat, based on either hydrogeomorphic class, or plant community type. For most natural wetland sites, it is generally not too difficult for an experience field biologist to correctly classify the habitat being evaluated. However, for sites that have been heavily disturbed or are recently restored from an alternate land use, such as agriculture, this interpretation can be tricky. The traditional VIBI requires an accurate classification, as the suite of metrics used to calculate a score are different for emergent, forested, and scrub-shrub wetlands. Eliminating the need to correctly classify the site, by simplifying the procedure to only two critical metrics will reduce the number of errors when assessing these degraded or restored sites.

3) The traditional VIBI was calibrated on specific wetland habitats, and therefore, is not valid if a substantial amount of upland habitat is included within the sample plot area. Recently restored or created sites again prove to be difficult, as the hydrology may take several years to equilibrate, and mistakes are made when deciding whether the ultimate endpoint of a site is wetland or upland. Including significant upland areas in the traditional VIBI analysis is likely to result in an erroneous interpretation as to

the development of a site. While only natural wetland data were included in the analysis of the VIBI-FQ procedure, the two metrics are derived from the FQAI and C of C species assignments, which are valid for the entire flora of Ohio. Therefore, it is expected that the procedure itself will also be valid for any habitat type, including riparian corridors.

4) The traditional VIBI procedures were developed on already existing natural wetlands, and several of the metrics are very sensitive to disturbance (making them excellent indicators of disturbance), but may be less sensitive to the type of changes which occur on a rapidly developing ecosystem. Both the diversity and dominance of sensitive species, as included in the updated VIBI, are expected to change proportionally as a site goes from bare earth to established ecosystem. This is critical, as typical monitoring periods for mitigation sites range from 5 to 10 years – much shorter than the amount of time required for an ecosystem to reach full maturity. This simplified approach is intended to illustrate the rapid changes occurring within the plant communities of these sites. The WEG has analyzed a number of mitigation sites (banks and permittee-responsible sites), in order to properly establish numeric expectations for plant community development. Preliminary analysis of these sites that a VIBI-FQ score of 50 is reasonably attainable for most sites within a typical mitigation monitoring period.

5) The traditional VIBI score includes ten different metrics in the calculation, and these metrics differ for each variation of the assessment technique applied (forested, scrub-shrub, and emergent), actually calculating a VIBI score using digital spreadsheets can be difficult and is prone to error. Simplifying the VIBI procedure to two universally applicable, easily calculated metrics reduces the complexity considerably. It is anticipated that this simplified procedure will also dramatically reduce the number of errors frequently encountered when performing the calculation.

6) Since the updated VIBI procedure is valid in any plant community type, it is expected to be a useful tool when comparing the overall ecological condition of sites targeted for preservation. This “apples to apples” comparison will make it easier to identify true reference sites, and score the “best of the best” habitats appropriately when prioritizing funding for various Ohio EPA grant programs focused on resource protection or restoration, such as 319 and WRRSP.

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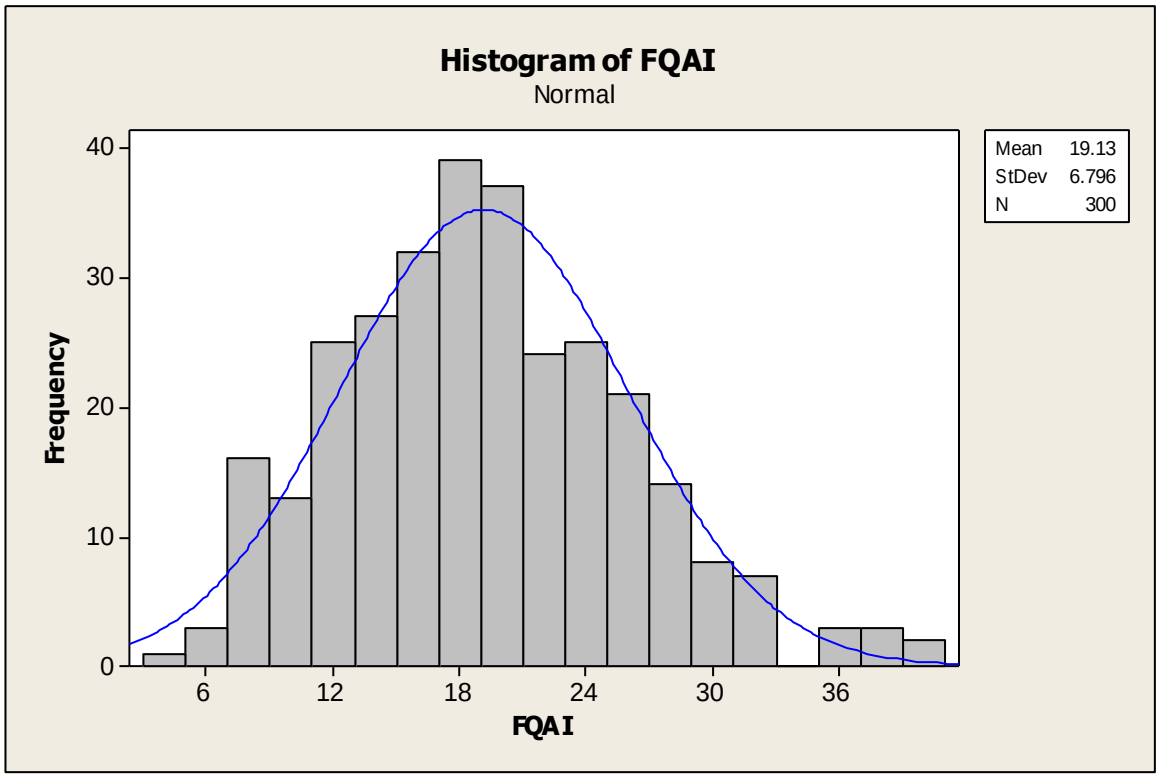

Figure 1. Histogram of FQAI values for 300 natural wetland sites in Ohio.

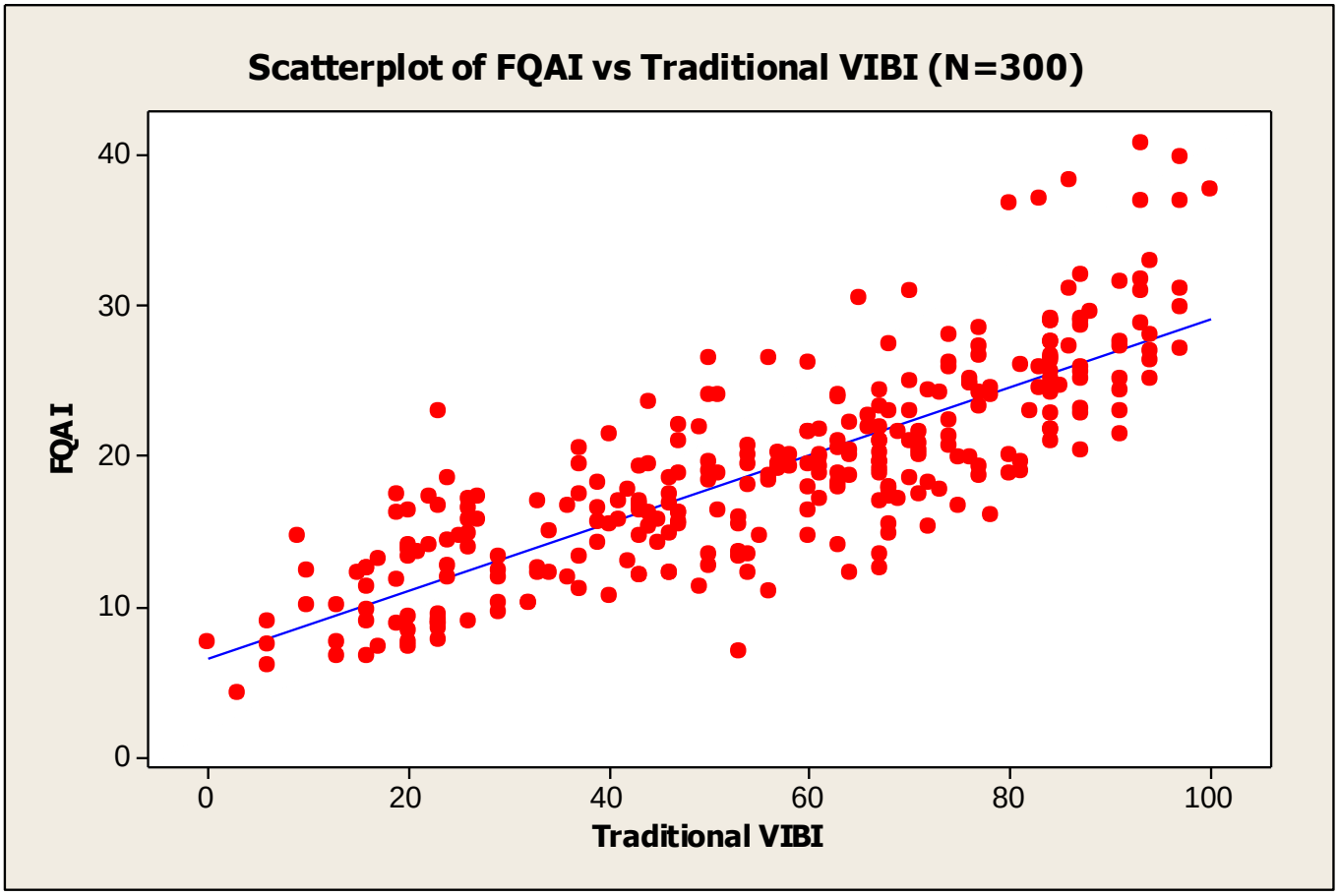

Figure 2. **Scatterplot of FQAI versus traditional VIBI.**

Regression Analysis: FQAI versus VIBI_SCORE

The regression equation is
FQAI = 6.50 + 0.225 VIBI_SCORE

Predictor	Coef	SE Coef	T	P
Constant	6.4982	0.5717	11.37	0.000
VIBI_SCORE	0.225429	0.009353	24.10	0.000

S = 3.96366 R-Sq = 66.1% R-Sq(adj) = 66.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	9127.0	9127.0	580.94	0.000
Residual Error	298	4681.8	15.7		
Total	299	13808.7			

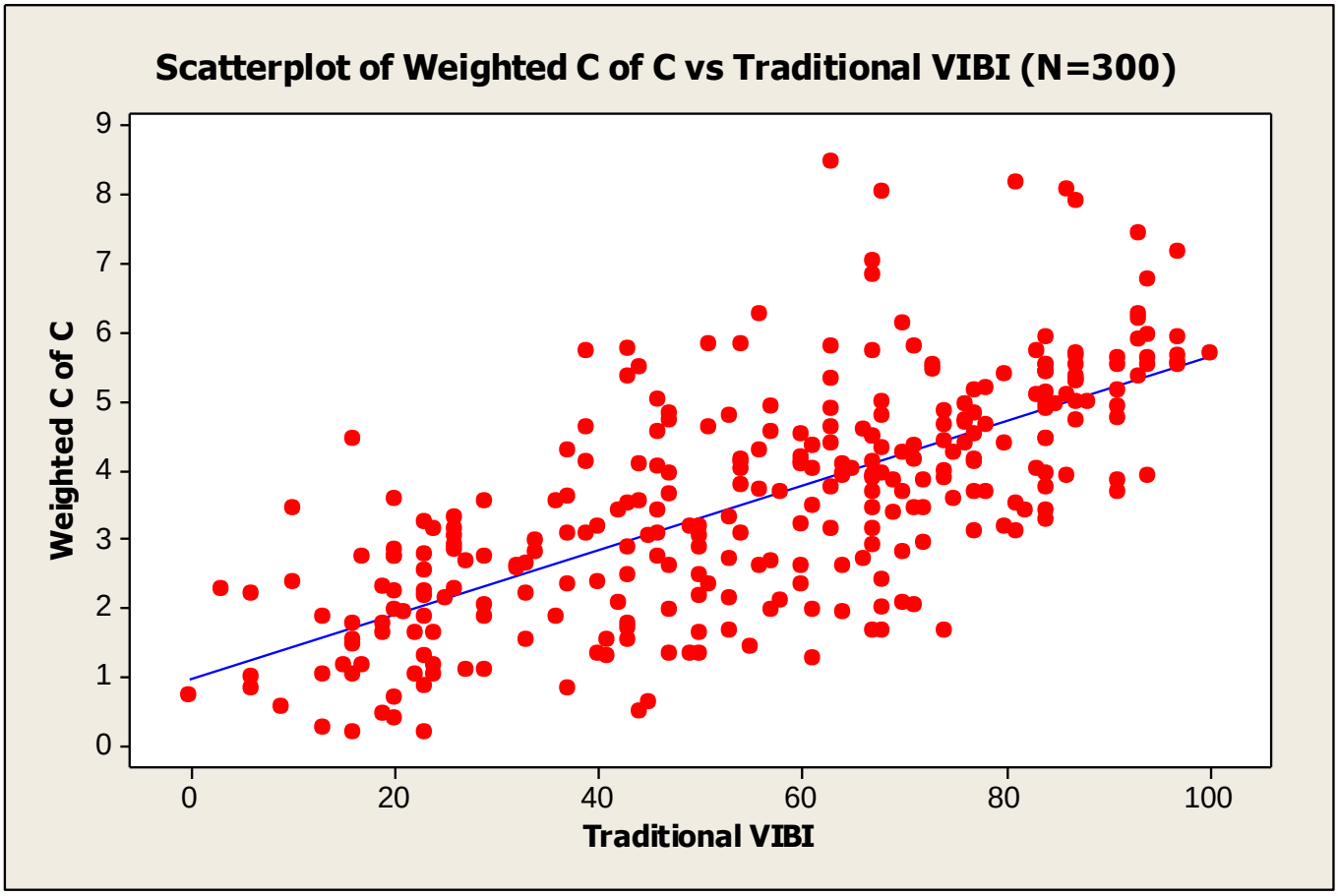

Figure 3. **Scatterplot of weighted C of C versus traditional VIBI.**

Regression Analysis: WT_COFC versus VIBI_SCORE

The regression equation is
WT_COFC = 0.971 + 0.0466 VIBI_SCORE

Predictor	Coef	SE Coef	T	P
Constant	0.9710	0.1712	5.67	0.000
VIBI_SCORE	0.046640	0.002800	16.66	0.000

S = 1.18674 R-Sq = 48.2% R-Sq(adj) = 48.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	390.69	390.69	277.40	0.000
Residual Error	298	419.69	1.41		
Total	299	810.38			

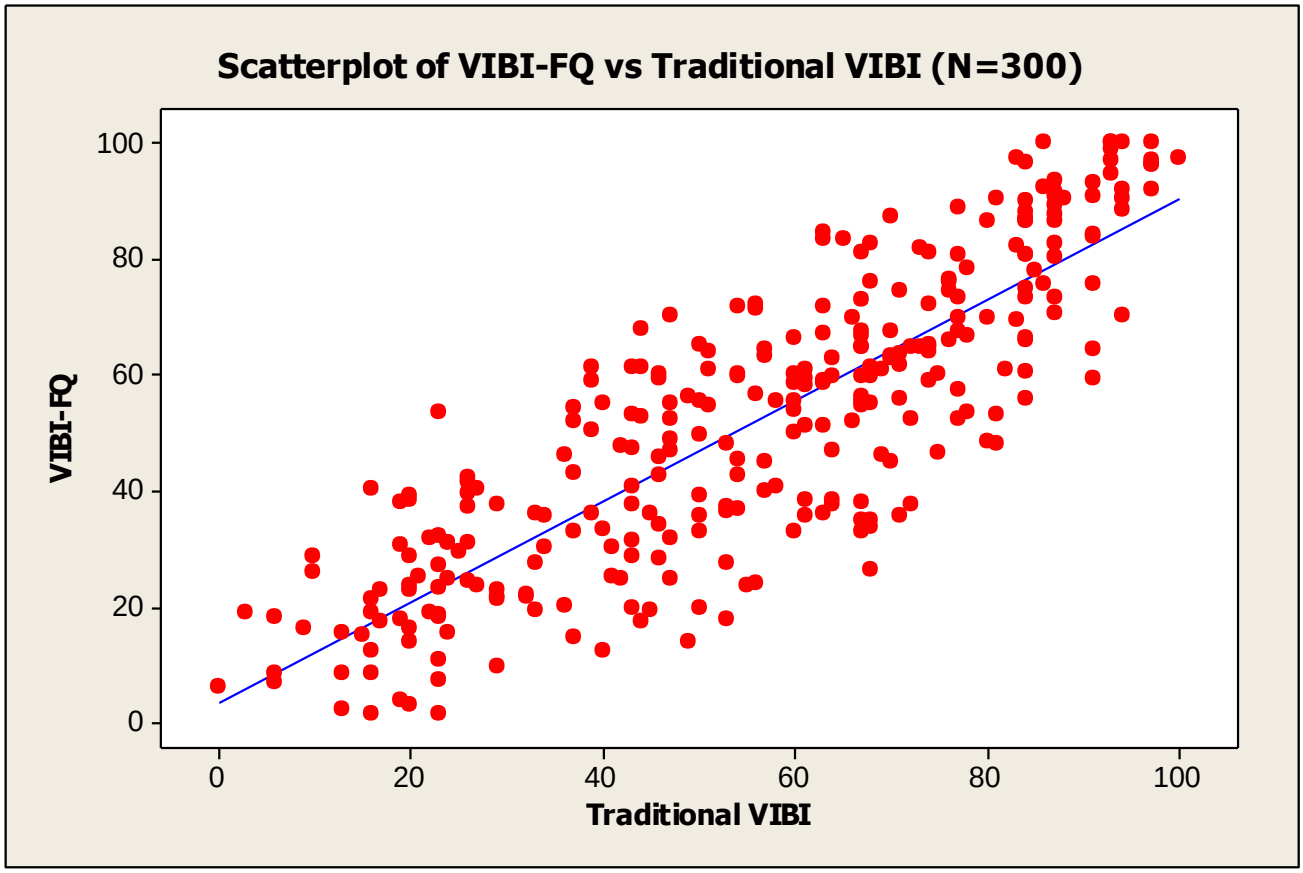

Figure 4. **Scatterplot of VIBI-FQ versus traditional VIBI.**

Regression Analysis: VIBI_FQ versus VIBI_SCORE

The regression equation is
VIBI_FQ = 3.33 + 0.869 VIBI_SCORE

Predictor	Coef	SE Coef	T	P
Constant	3.329	1.945	1.71	0.088
VIBI_SCORE	0.86880	0.03182	27.31	0.000

S = 13.4843 R-Sq = 71.4% R-Sq(adj) = 71.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	135565	135565	745.57	0.000
Residual Error	298	54184	182		
Total	299	189749			

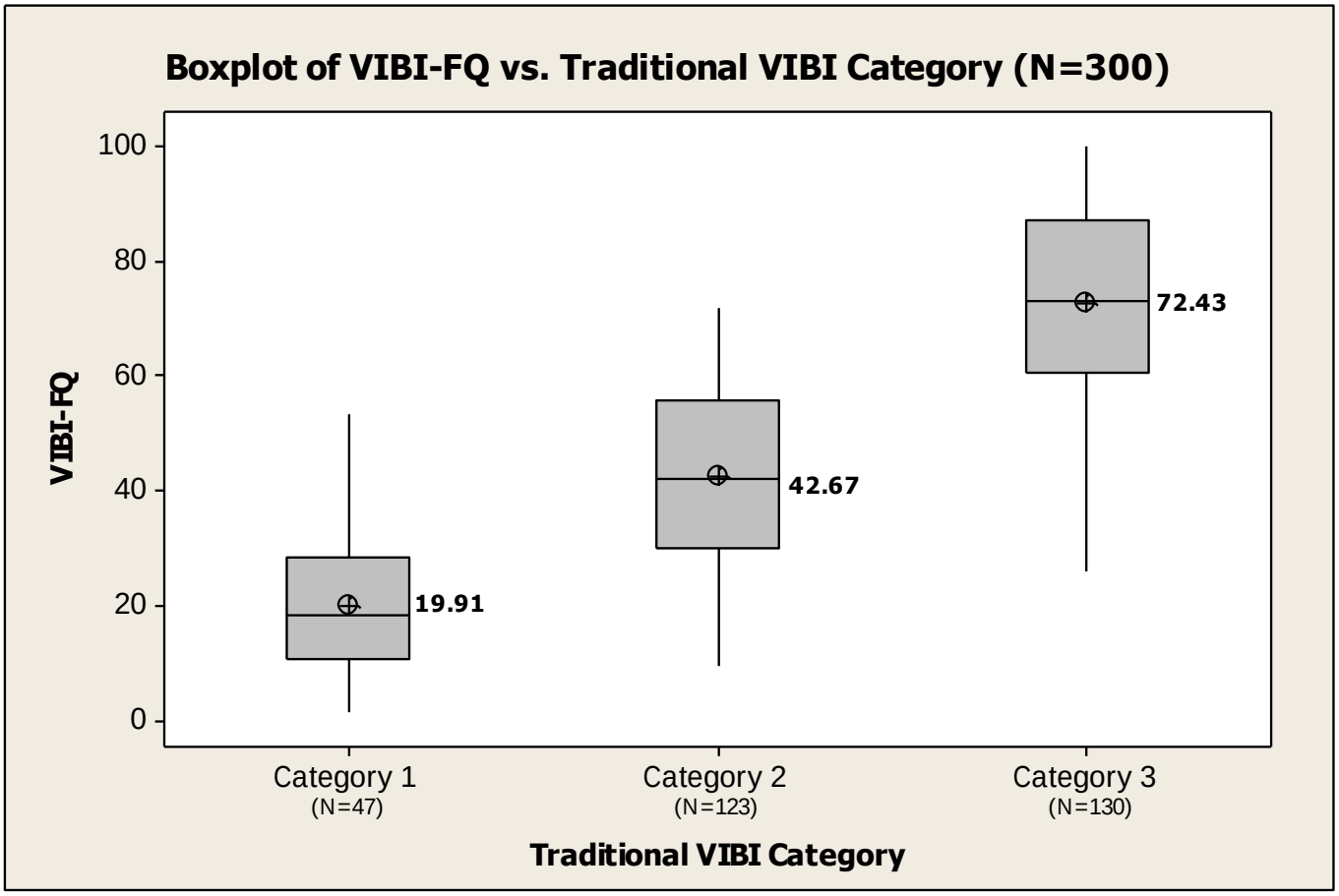

Figure 5. **Boxplot of VIBI-FQ versus traditional VIBI category.**

One-way ANOVA: VIBI_FQ versus VIBI_CAT

```
Source     DF      SS     MS       F      P
VIBI_CAT    2  113336  56668  220.26  0.000
Error     297   76412    257
Total     299  189749

S = 16.04   R-Sq = 59.73%   R-Sq(adj) = 59.46%

Level                  N   Mean  StDev
Category 1            47  19.91  11.67
Category 2           123  42.67  15.66
Category 3           130  72.43  17.66

                     Individual 95% CIs For Mean Based on Pooled StDev
Level                 +---------+---------+---------+---------
Category 1            (--*--)
Category 2                          (*-)
Category 3                                            (-*-)
                      +---------+---------+---------+---------
                     15        30        45        60
Pooled StDev = 16.04

Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of VIBI_CAT

Individual confidence level = 98.01%

VIBI_CAT = Category 1          subtracted from:

VIBI_CAT             Lower  Center  Upper
Category 2           16.33   22.76  29.20
Category 3           46.13   52.52  58.91

VIBI_CAT             ----+---------+---------+---------+-----
Category 2                           (-*--)
Category 3                                       (--*--)
                     ----+---------+---------+---------+-----
                       -25         0        25        50


VIBI_CAT = Category 2          subtracted from:

VIBI_CAT             Lower  Center  Upper
Category 3           25.03   29.75  34.47

VIBI_CAT             ----+---------+---------+---------+-----
Category 3                             (-*-)
                     ----+---------+---------+---------+-----
                       -25         0        25        50
```

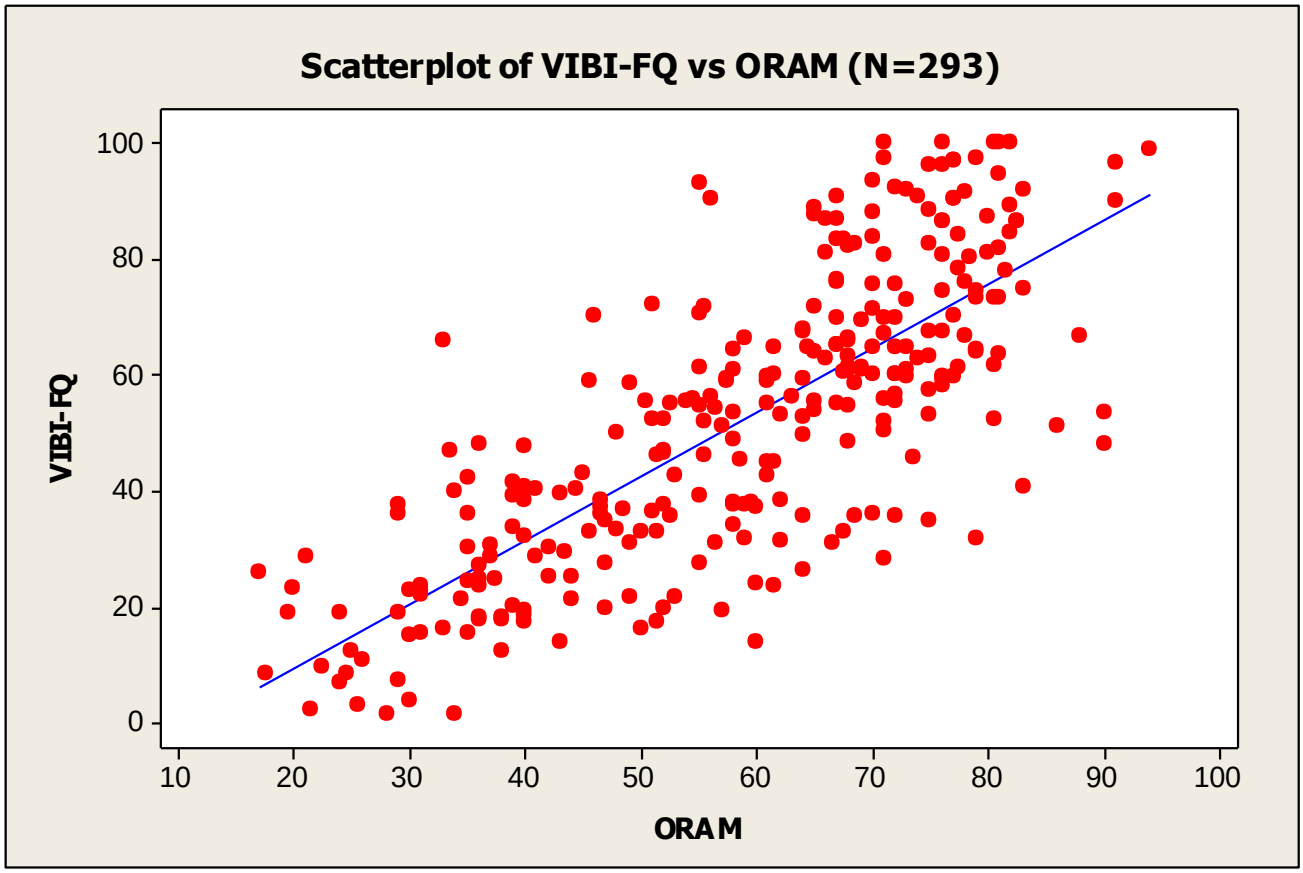

Figure 6. **Scatterplot of VIBI-FQ versus ORAM.**

Regression Analysis: VIBI_FQ versus ORAM_V5

The regression equation is
VIBI_FQ = - 12.8 + 1.11 ORAM_V5

Predictor	Coef	SE Coef	T	P
Constant	-12.850	3.284	-3.91	0.000
ORAM_V5	1.10822	0.05351	20.71	0.000

S = 15.9151 R-Sq = 59.6% R-Sq(adj) = 59.4%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	108636	108636	428.90	0.000
Residual Error	291	73707	253		
Total	292	182343			

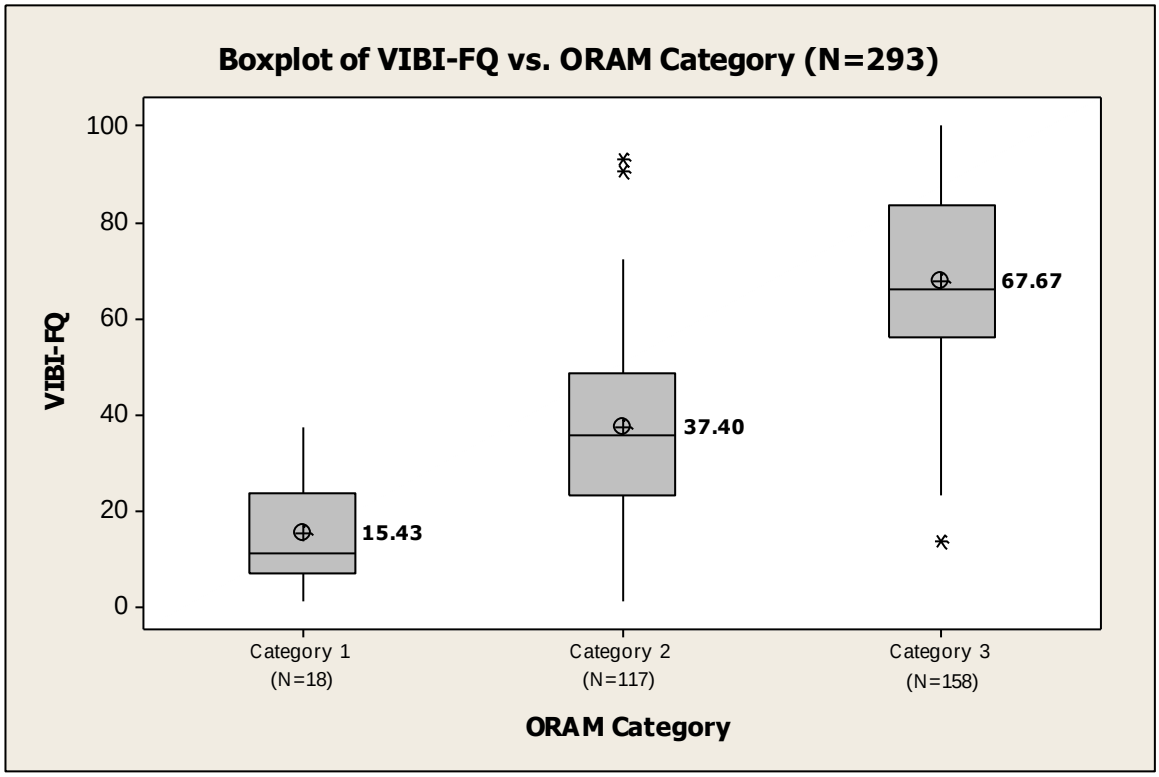

Figure 7. Boxplot of VIBI-FQ versus ORAM category.

One-way ANOVA: VIBI_FQ versus ORAM_CAT

```
Source     DF      SS     MS       F      P
ORAM_CAT    2   87800  43900  134.66  0.000
Error     290   94543    326
Total     292  182343

S = 18.06   R-Sq = 48.15%   R-Sq(adj) = 47.79%

Level                   N   Mean  StDev
Category 1             18  15.43  11.15
Category 2            117  37.40  17.24
Category 3            158  67.67  19.21

                      Individual 95% CIs For Mean Based on
                      Pooled StDev
Level                 ------+---------+---------+---------+---
Category 1            (-----*----)
Category 2                          (-*-)
Category 3                                              (*-)
                      ------+---------+---------+---------+---
                           16        32        48        64

Pooled StDev = 18.06

Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of ORAM_CAT

Individual confidence level = 98.01%

ORAM_CAT = Category 1           subtracted from:

ORAM_CAT              Lower  Center  Upper
Category 2            11.27   21.97  32.67
Category 3            41.73   52.24  62.76

ORAM_CAT              ----+---------+---------+---------+-----
Category 2                            (---*---)
Category 3                                        (---*---)
                      ----+---------+---------+---------+-----
                        -25         0        25        50

ORAM_CAT = Category 2           subtracted from:

ORAM_CAT              Lower  Center  Upper
Category 3            25.12   30.28  35.43

ORAM_CAT              ----+---------+---------+---------+-----
Category 3                                  (-*-)
                      ----+---------+---------+---------+-----
                        -25         0        25        50
```

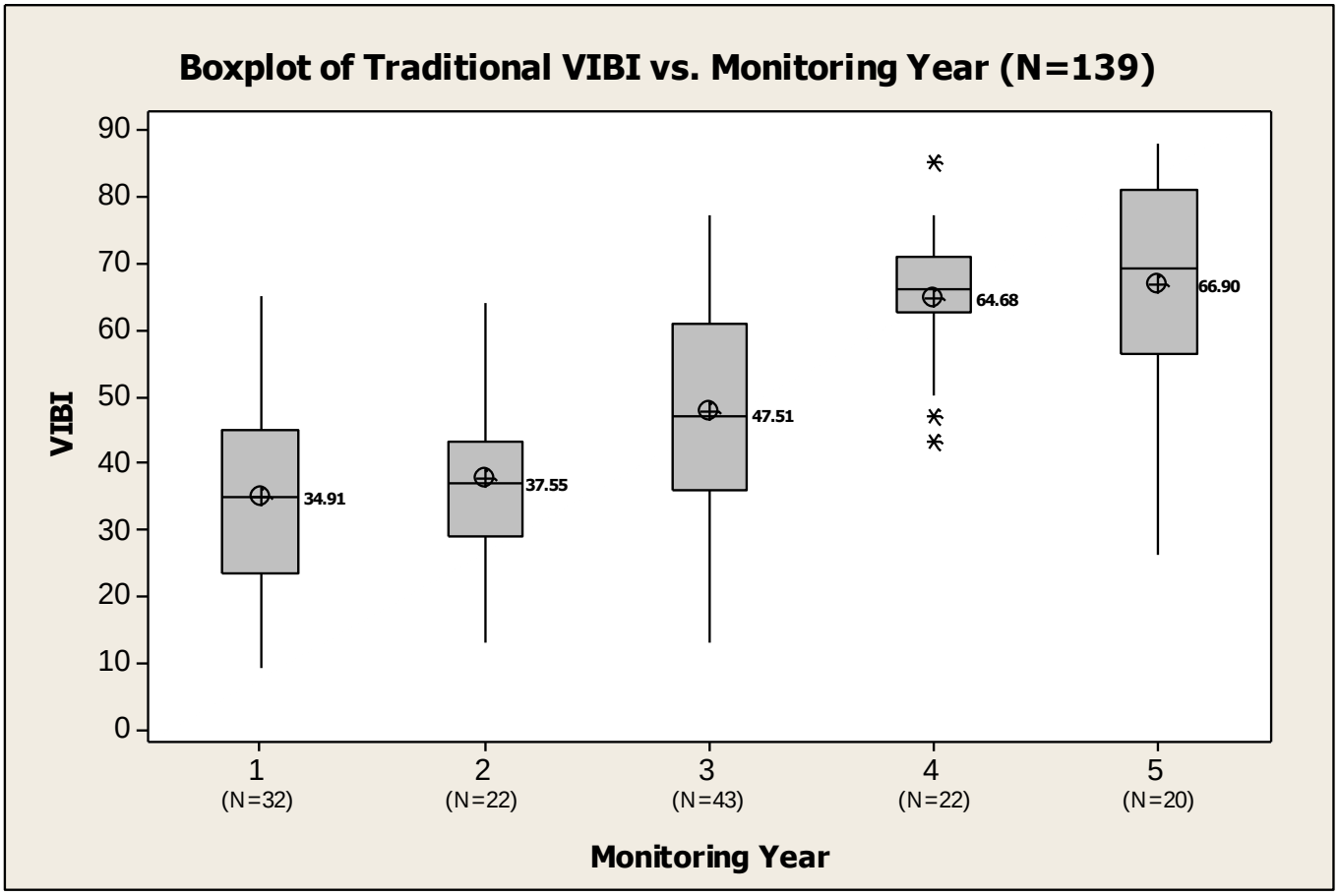

Figure 8. Boxplot of VIBI versus monitoring year for mitigation wetlands.

One-way ANOVA: VIBI versus MON_YEAR

```
Source     DF     SS    MS      F      P
MON_YEAR    4  21127  5282  24.17  0.000
Error     134  29279   219
Total     138  50407

S = 14.78   R-Sq = 41.91%   R-Sq(adj) = 40.18%

                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N   Mean  StDev  -----+---------+---------+---------+----
1      32  34.91  15.08  (---*---)
2      22  37.55  11.63   (----*----)
3      43  47.51  16.74             (---*--)
4      22  64.68   9.49                       (----*----)
5      20  66.90  17.37                        (-----*----)
                          -----+---------+---------+---------+----
                              36        48        60        72
Pooled StDev = 14.78

Grouping Information Using Tukey Method

MON_YEAR   N   Mean  Grouping
5         20  66.90  A
4         22  64.68  A
3         43  47.51    B
2         22  37.55    B C
1         32  34.91      C

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of MON_YEAR

Individual confidence level = 99.35%

MON_YEAR = 1 subtracted from:

MON_YEAR  Lower  Center  Upper  -------+---------+---------+---------+--
2         -8.68    2.64  13.96               (---*----)
3          3.06   12.61  22.15                   (---*---)
4         18.46   29.78  41.09                         (----*---)
5         20.34   31.99  43.64                          (----*---)
                                -------+---------+---------+---------+--
                                     -25         0        25        50
MON_YEAR = 2 subtracted from:

MON_YEAR  Lower  Center  Upper  -------+---------+---------+---------+--
3         -0.75    9.97  20.68                  (---*---)
4         14.81   27.14  39.46                        (----*----)
5         16.73   29.35  41.98                         (----*----)
                                -------+---------+---------+---------+--
                                     -25         0        25        50
MON_YEAR = 3 subtracted from:

MON_YEAR  Lower  Center  Upper  -------+---------+---------+---------+--
4          6.46   17.17  27.88                    (---*---)
5          8.33   19.39  30.45                    (----*---)
                                -------+---------+---------+---------+--
                                     -25         0        25        50


MON_YEAR = 4 subtracted from:

MON_YEAR   Lower  Center  Upper  -------+---------+---------+---------+--
5         -10.41    2.22  14.84              (----*----)
                                 -------+---------+---------+---------+--
                                      -25         0        25        50
```

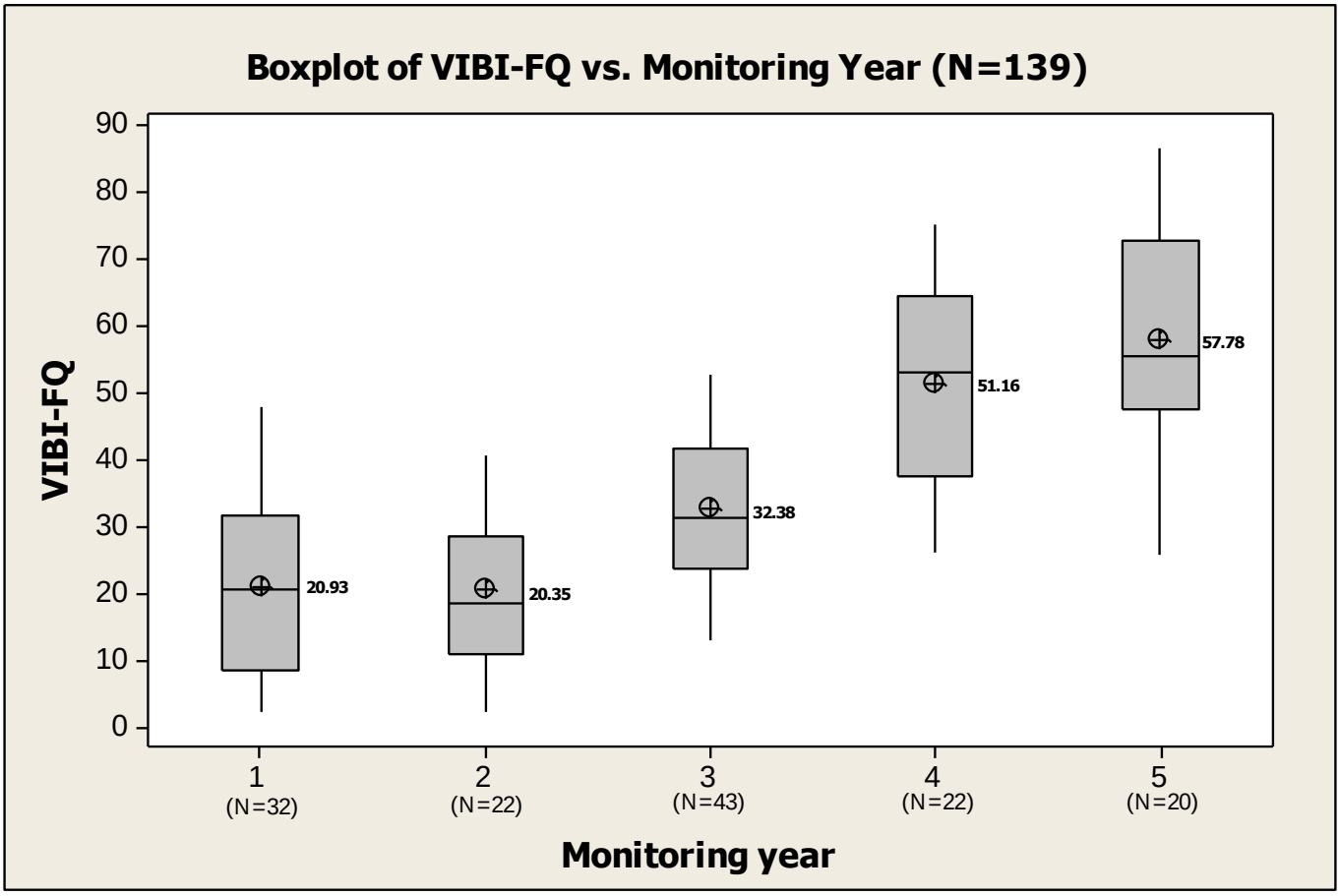

Figure 9. Boxplot of VIBI-FQ versus monitoring year for mitigation wetlands.

One-way ANOVA: VIBI_R versus MON_YEAR

```
Source     DF     SS    MS      F      P

MON_YEAR    4  27432  6858  39.91  0.000
Error     134  23027   172
Total     138  50459

S = 13.11   R-Sq = 54.37%   R-Sq(adj) = 53.00%

                        Individual 95% CIs For Mean Based on
                        Pooled StDev
Level   N   Mean  StDev   +---------+---------+---------+---------
1      32  20.93  12.66    (--*--)
2      22  20.35  11.17   (---*--)
3      43  32.38  11.46            (--*-)
4      22  51.16  15.28                      (---*---)
5      20  57.78  16.26                           (---*--)
                         +---------+---------+---------+---------
                        15        30        45        60
Pooled StDev = 13.11

Grouping Information Using Tukey Method

MON_YEAR   N   Mean  Grouping
5         20  57.78  A
4         22  51.16  A
3         43  32.38    B
1         32  20.93      C
2         22  20.35      C

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of MON_YEAR

Individual confidence level = 99.35%

MON_YEAR = 1 subtracted from:

MON_YEAR   Lower  Center  Upper  ---------+---------+---------+---------+
2         -10.62   -0.58   9.46                (---*---)
3           2.99   11.45  19.91                     (---*--)
4          20.19   30.23  40.27                            (---*---)
5          26.52   36.85  47.18                               (---*---)
                            ---------+---------+---------+---------+
                                   -25         0        25        50
MON_YEAR = 2 subtracted from:

MON_YEAR  Lower  Center  Upper  ---------+---------+---------+---------+
3          2.53   12.03  21.53                    (---*---)
4         19.88   30.81  41.74                           (---*----)
5         26.23   37.43  48.62                             (----*---)
                           ---------+---------+---------+---------+
                                  -25         0        25        50

MON_YEAR = 3 subtracted from:

MON_YEAR  Lower  Center  Upper  ---------+---------+---------+---------+
4          9.28   18.78  28.28                       (---*--)
5         15.59   25.40  35.21                         (---*---)
                           ---------+---------+---------+---------+
                                  -25         0        25        50

MON_YEAR = 4 subtracted from:

MON_YEAR  Lower  Center  Upper  ---------+---------+---------+---------+
5         -4.58    6.62  17.82                  (----*---)
                           ---------+---------+---------+---------+
                                  -25         0        25        50
```

Table 1. Example raw field vegetation data collected for VIBI-FQ calculation.

Species	C of C	Intensive Module 1 Cover Class	Intensive Module 2 Cover Class	Intensive Module 3 Cover Class	Intensive Module 4 Cover Class	Residual Modules Cover Class
Typha latifolia	1	7	7	4	7	
Vitis riparia	3	9	8	3	8	
Polygonum amphibium	4	9	8	4	8	
Cornus amomum	2		6	9	7	
Urtica dioica var. procera	1	3	2		2	
Boehmeria cylindrica	4	2			2	
Acer saccharinum	3		3			
Ipomoea purpurea	0		2			
Cyperus esculentus	0			1		
Asclepias incarnata	4					2
Sambucus canadensis	3					2
Parthenocissus quinquefolia	2					1

Table 2. Example reduced field vegetation data collected for VIBI-FQ calculation.

Species	C of C	Intensive Module 1 Cover Class Midpoint	Intensive Module 2 Cover Class Midpoint	Intensive Module 3 Cover Class Midpoint	Intensive Module 4 Cover Class Midpoint	Residual Modules Cover Class Midpoint	Species Total Cover	Species Relative Cover	Species Cover-Weighted CofC
Typha latifolia	1	0.375	0.375	0.035	0.375		1.160000	0.168722	0.168722
Vitis riparia	3	0.85	0.625	0.015	0.625		2.115000	0.307627	0.922882
Polygonum amphibium	4	0.85	0.625	0.035	0.625		2.135000	0.310536	1.242146
Cornus amomum	2		0.175	0.85	0.375		1.400000	0.203630	0.407261
Urtica dioica var. procera	1	0.015	0.005		0.005		0.025000	0.003636	0.003636
Boehmeria cylindrica	4	0.005			0.005		0.010000	0.001455	0.005818
Acer saccharinum	3		0.015				0.015000	0.002182	0.006545
Ipomoea purpurea	0		0.005				0.005000	0.000727	0.000000
Cyperus esculentus	0			0.0001			0.000100	0.000015	0.000000
Asclepias incarnata	4					0.005	0.005000	0.000727	0.002909
Sambucus canadensis	3					0.005	0.005000	0.000727	0.002182
Parthenocissus quinquefolia	2					0.0001	0.000100	0.000015	0.000029
TOTALS	**27**						**6.875200**	**1.000000**	**2.762131**

Table 3. VIBI, ORAM, and VIBI-FQ data for natural wetlands monitored by the Ohio EPA Wetland Ecology Group from 1999 to 2012.

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
1999	2-Meadows Swamp	depression	shrub	49	Category 2	60	Category 2	19.47	23.68	4.17	34.74	**58.42**
1999	Area K Plot #2	depression	shrub	61.5	Category 3	67	Category 3	21	27.5	4.49	37.39	**64.89**
1999	Berger Road	riverine	emergent	24.5	Category 1	16	Category 1	6.68	0	1.02	8.48	**8.48**
1999	Big Woods	depression	forest	68.5	Category 3	63	Category 3	18.83	22.08	4.37	36.44	**58.52**
1999	Bloomville Swamp	impoundment	emergent	36	Category 2	19	Category 1	11.7	4.25	1.63	13.54	**17.79**
1999	Collier Woods	riverine	forest	73.5	Category 3	46	Category 2	14.76	11.9	4.05	33.71	**45.61**
1999	Daughmer	depression	emergent	68	Category 3	84	Category 3	21.78	29.45	4.44	36.99	**66.44**
1999	Drew Woods	depression	shrub	70	Category 3	46	Category 2	17.35	18.38	5.02	41.87	**60.24**
1999	Gahanna 1st	depression	shrub	82.5	Category 3	87	Category 3	25.81	39.53	5.64	47	**86.52**
1999	Gahanna 4th 1999	depression	shrub	67.5	Category 3	37	Category 2	11.08	2.7	3.61	30.12	**32.82**
1999	Graham Rd.	depression	forest	26	Category 1	23	Category 1	8.88	0	1.28	10.68	**10.68**
1999	Killdeer Plains	depression	forest	58.5	Category 2	54	Category 2	18	20	3.05	25.45	**45.45**
1999	Kiser Lake	slope	emergent	70	Category 3	86	Category 3	27.29	43.23	3.91	32.58	**75.81**
1999	LaRue Woods	depression	forest	55	Category 2	33	Category 2	12.2	5.5	2.63	21.93	**27.43**
1999	Lawrence Low 2	depression	forest	48	Category 2	40	Category 2	15.41	13.53	2.35	19.6	**33.13**
1999	Leafy Oak 1999	depression	forest	78	Category 3	78	Category 3	24.48	36.2	3.66	30.47	**66.67**
1999	Mishne 1999	depression	emergent	19.5	Category 1	3	Category 1	4.24	0	2.26	18.83	**18.83**
1999	Mud Lake (Bog)	slope	emergent	91	Category 3	84	Category 3	29	47.5	5.91	49.21	**96.71**
1999	Mud Lake (Fen)	slope	emergent	91	Category 3	84	Category 3	27.55	43.88	5.53	46.08	**89.95**
1999	Orange Rd.	depression	forest	45	Category 2	37	Category 2	19.44	23.6	2.33	19.45	**43.05**
1999	Oyer Tamarack	bog	forest	79	Category 3	100	Category 3	37.69	50	5.67	47.22	**97.22**
1999	Oyer Wood Frog	depression	shrub	69	Category 3	51	Category 2	18.86	22.15	4.63	38.56	**60.71**
1999	Palmer Rd.	depression	emergent	17.5	Category 1	6	Category 1	6.1	0	0.99	8.25	**8.25**
1999	Scofield Plot #2	riverine	emergent	40	Category 2	23	Category 1	8.78	0	2.23	18.58	**18.58**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
1999	Silver Lake	slope	emergent	82	Category 3	93	Category 3	36.95	50	6.17	50	**100**
1999	Slate Run	depression	shrub	76	Category 3	71	Category 3	20.41	26.03	5.8	48.29	**74.32**
1999	Springville Marsh	slope	emergent	51	Category 2	74	Category 3	25.92	39.8	3.89	32.4	**72.2**
1999	Stages Pond	depression	emergent	38	Category 2	6	Category 1	7.49	0	2.18	18.21	**18.21**
1999	The Rookery	depression	shrub	69	Category 3	68	Category 3	17.89	19.73	4.99	41.56	**61.29**
1999	Tipp-Elizabeth Rd	riverine	forest	29	Category 1	29	Category 2	13.22	8.05	3.54	29.46	**37.51**
1999	Wilson Plot #2	riverine	shrub	77	Category 3	64	Category 3	20.3	25.75	4.08	34	**59.75**
2000	Bates Creek	riverine	emergent	64	Category 3	50	Category 2	18.91	22.28	1.62	13.47	**35.74**
2000	Birkner Pond	depression	emergent	30	Category 2	15	Category 1	12.22	5.55	1.16	9.64	**15.19**
2000	Blackjack Rd Back	depression	shrub	66	Category 3	84	Category 3	26.38	40.95	5.52	45.99	**86.94**
2000	Blackjack Rd Front	depression	shrub	55.5	Category 2	63	Category 3	20.92	27.3	5.32	44.33	**71.62**
2000	Brown Lake Bog	depression	forest	78	Category 3	76	Category 3	24.85	37.13	4.66	38.85	**75.98**
2000	Burton Lake Vernal	depression	shrub	67	Category 3	76	Category 3	24.87	37.18	4.71	39.27	**76.45**
2000	City of Mansfield	slope	forest	55	Category 2	87	Category 3	20.37	25.93	5.34	44.53	**70.46**
2000	Eagle Creek Beaver	riverine	emergent	68	Category 3	82	Category 3	23.02	32.55	3.4	28.33	**60.88**
2000	Eagle Creek Bog	bog	emergent	81	Category 3	73	Category 3	24.25	35.63	5.52	46.03	**81.65**
2000	Eagle Creek Vernal	depression	forest	69	Category 3	83	Category 3	24.5	36.25	4	33.33	**69.58**
2000	Fowler Woods	depression	forest	79	Category 3	76	Category 3	25.14	37.85	4.38	36.49	**74.34**
2000	Fowler Woods Shrub	depression	shrub	79	Category 3	51	Category 2	16.32	15.8	5.8	48.33	**64.13**
2000	Frieds Bog	bog	shrub	77	Category 3	93	Category 3	28.77	46.93	6.26	50	**96.93**
2000	Grand River Terraces	depression	shrub	73	Category 3	97	Category 3	27.13	42.83	5.9	49.17	**92**
2000	Guilford Lake	riverine	emergent	45.5	Category 2	50	Category 2	12.66	6.65	3.16	26.33	**32.98**
2000	Herrick Fen	slope	emergent	64	Category 3	70	Category 2	30.96	50	2.08	17.3	**67.3**
2000	Killbuck Swamp	riverine	forest	33	Category 2	9	Category 1	14.68	11.7	0.55	4.58	**16.28**
2000	Kinnikinnick	slope	emergent	66	Category 3	67	Category 3	23.27	33.18	5.73	47.75	**80.93**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2000	Koelliker Fen	slope	shrub	72	Category 3	86	Category 3	31.03	50	5.06	42.2	**92.2**
2000	Marsh Wetlands	riverine	emergent	75	Category 3	77	Category 3	19.32	23.3	4.1	34.17	**57.47**
2000	McKee Bog	bog	emergent	56	Category 2	94	Category 3	26.37	40.93	5.94	49.52	**90.45**
2000	Mentor Marsh	depression	forest	34	Category 2	57	Category 2	19.4	23.5	1.98	16.52	**40.01**
2000	N.Kingsville S.B. Swamp	slope	forest	67	Category 3	84	Category 3	26.71	41.78	5.41	45.09	**86.86**
2000	Pallister	depression	forest	74	Category 3	91	Category 3	27.57	43.93	5.61	46.73	**90.65**
2000	Pawnee Rd.	depression	forest	70	Category 3	84	Category 3	28.92	47.3	4.87	40.58	**87.88**
2000	Sheldons Marsh Plot 2	coastal	emergent	79	Category 3	47	Category 2	16.13	15.33	1.97	16.42	**31.74**
2000	Singer Lake Leatherleaf	bog	shrub	82	Category 3	63	Category 3	23.82	34.55	8.47	50	**84.55**
2000	Singer Lake Marsh	depression	emergent	86	Category 3	63	Category 3	17.91	19.78	3.75	31.24	**51.01**
2000	Swamp Cottonwood	bog	shrub	76	Category 3	97	Category 3	31.11	50	5.56	46.34	**96.34**
2000	Tinkers Creek	riverine	emergent	80.5	Category 3	77	Category 3	18.69	21.73	3.66	30.53	**52.25**
2000	Towners Woods	depression	shrub	65	Category 3	54	Category 2	19.34	23.35	5.83	48.55	**71.9**
2000	Townline Forest	depression	forest	64.5	Category 3	73	Category 3	17.71	19.28	5.44	45.32	**64.59**
2000	Townline Shrub	depression	shrub	62	Category 3	43	Category 2	12	5	5.76	48	**53**
2000	US 42	riverine	forest	31	Category 2	13	Category 1	6.63	0	1.86	15.53	**15.53**
2000	Watercress Fen	riverine	emergent	77.5	Category 3	44	Category 2	16.2	15.5	5.5	45.82	**61.32**
2000	Watercress Marsh	slope	shrub	61	Category 3	74	Category 2	28	45	1.68	13.96	**58.96**
2000	White Pine Bog	slope	forest	83	Category 3	94	Category 3	28.03	45.08	5.6	46.67	**91.75**
2001	900a South Marsh	riverine	emergent	68	Category 3	84	Category 3	25.49	38.73	3.28	27.34	**66.07**
2001	Arcola Creek	coastal	emergent	75	Category 3	67	Category 3	12.49	6.23	3.44	28.66	**34.88**
2001	Baker Swamp	riverine	emergent	81	Category 3	71	Category 3	21.61	29.03	4.15	34.62	**63.65**
2001	Ballfield Fen	slope	emergent	83	Category 3	84	Category 3	25.17	37.93	4.43	36.91	**74.83**
2001	Ballfield Marsh	riverine	emergent	83	Category 3	58	Category 2	19.23	23.08	2.1	17.5	**40.58**
2001	Bradley Woods	depression	forest	81.5	Category 3	85	Category 3	24.63	36.58	4.96	41.31	**77.89**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2001	Brunswick Lake Wetland B	impoundment	emergent	58	Category 2	67	Category 3	19.64	24.1	1.68	13.96	**38.06**
2001	Calamus	depression	emergent	68	Category 3	57	Category 2	20.2	25.5	4.54	37.81	**63.31**
2001	Cemetery Road	slope	emergent	68.5	Category 3	87	Category 3	25.49	38.73	5.27	43.92	**82.64**
2001	Crall Woods Forest	depression	forest	77.5	Category 3	91	Category 3	27.33	43.33	4.91	40.88	**84.2**
2001	Crall Woods Shrub	depression	shrub	77.5	Category 3	78	Category 3	24.07	35.18	5.19	43.27	**78.44**
2001	Dever South	depression	emergent	22.5	Category 1	29	Category 2	10.2	0.5	1.09	9.04	**9.54**
2001	Dupont Marsh	coastal	emergent	61.5	Category 3	55	Category 2	14.67	11.68	1.42	11.84	**23.51**
2001	Eagle Cr Buttonbush	depression	shrub	81	Category 3	93	Category 3	31	50	5.36	44.68	**94.68**
2001	Eagle Creek Marsh	impoundment	emergent	75	Category 3	81	Category 3	19.61	24.03	3.51	29.23	**53.25**
2001	Edison Woods	slope	forest	56	Category 2	49	Category 2	21.92	29.8	3.17	26.44	**56.24**
2001	Gallagher Fen	slope	emergent	81	Category 3	97	Category 3	39.79	50	7.15	50	**100**
2001	Holmesville prairie	slope	emergent	72	Category 3	91	Category 3	24.36	35.9	4.76	39.64	**75.54**
2001	Lake Abrams Center	riverine	emergent	40	Category 2	33	Category 2	12.52	6.3	1.54	12.85	**19.15**
2001	Limeridge Rd. BBS	depression	shrub	45.5	Category 2	39	Category 2	18.19	20.48	4.62	38.53	**59.01**
2001	Lodi North	depression	emergent	29	Category 1	45	Category 2	14.22	10.55	3.04	25.34	**35.89**
2001	Mantua Bog	slope	emergent	94	Category 3	93	Category 3	40.75	50	5.87	48.95	**98.95**
2001	Mitchell Woods Forest	depression	forest	72	Category 3	77	Category 3	24.17	35.43	4.13	34.4	**69.83**
2001	Mitchell Woods Shrub	depression	shrub	72	Category 3	67	Category 3	21	27.5	4.49	37.42	**64.92**
2001	Mondial Rd	riverine	forest	24	Category 1	16	Category 1	12.53	6.33	1.53	12.79	**19.11**
2001	Morgan Marsh	depression	emergent	77	Category 3	94	Category 3	25.07	37.68	3.9	32.48	**70.15**
2001	Nazarene	depression	forest	17	Category 1	10	Category 1	12.36	5.9	2.38	19.83	**25.73**
2001	North Pond Emergent	coastal	emergent	90	Category 3	78	Category 3	15.99	14.98	4.64	38.68	**53.65**
2001	Old Woman Cr Forest	riverine	forest	51.5	Category 2	17	Category 1	13.14	7.85	1.17	9.72	**17.57**
2001	Old Woman Cr Inlet	coastal	forest	71	Category 3	37	Category 2	20.52	26.3	3.06	25.49	**51.79**
2001	Old Woman Creek Mouth	coastal	emergent	71	Category 3	46	Category 2	12.14	5.35	2.74	22.82	**28.17**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2001	Prairie Rd. Fen	slope	emergent	76	Category 3	86	Category 3	38.36	50	8.06	50	**100**
2001	Rickenbacker 2001	depression	emergent	51.5	Category 2	67	Category 3	13.44	8.6	2.91	24.24	**32.84**
2001	Steels Corner	riverine	emergent	30	Category 2	19	Category 1	8.78	0	0.46	3.85	**3.85**
2001	Valley Road	slope	emergent	55.5	Category 2	69	Category 2	17.16	17.9	3.37	28.07	**45.97**
2001	Willard Marsh	bog	forest	33	Category 2	76	Category 3	19.8	24.5	4.96	41.31	**65.81**
2002	Beulah Beach	coastal	emergent	70	Category 3	63	Category 3	14.02	10.05	3.14	26.14	**36.19**
2002	Blackfork Swamp	riverine	forest	62	Category 3	61	Category 2	18.76	21.9	1.98	16.51	**38.41**
2002	Broken Sword Meadow	riverine	emergent	28	Category 1	16	Category 1	8.94	0	0.18	1.54	**1.54**
2002	Buckeye Furnace	riverine	shrub	66.5	Category 3	26	Category 2	14.84	12.1	2.28	19.03	**31.13**
2002	East Branch Forest	slope	forest	76	Category 3	61	Category 2	21.71	29.28	3.47	28.92	**58.2**
2002	Falling Tree	impoundment	shrub	73	Category 3	67	Category 3	19.16	22.9	6.81	50	**72.9**
2002	Foxes Marsh	coastal	emergent	57	Category 2	45	Category 2	15.67	14.18	0.62	5.13	**19.3**
2002	Franklin Church Rd	riverine	emergent	76	Category 3	91	Category 3	21.38	28.45	3.68	30.69	**59.14**
2002	Greendale BBS	riverine	shrub	65	Category 3	60	Category 2	17.95	19.88	4.09	34.08	**53.95**
2002	Hewitt Fork	impoundment	emergent	51	Category 2	72	Category 3	18.14	20.35	3.85	32.06	**52.41**
2002	Irwin Center Meadow	depression	emergent	71	Category 3	93	Category 3	31.75	50	7.41	50	**100**
2002	Irwin East Meadow	depression	emergent	77	Category 3	81	Category 3	26.08	40.2	8.18	50	**90.2**
2002	Kent Bog Leatherleaf	bog	shrub	75	Category 3	68	Category 3	23.02	32.55	8.03	50	**82.55**
2002	Kent Bog Tamarack	bog	forest	75	Category 3	67	Category 3	17	17.5	7.03	50	**67.5**
2002	Lake Abrams South	riverine	emergent	40	Category 2	64	Category 2	12.24	5.6	3.94	32.86	**38.46**
2002	Mancy Tract N. Meadow	depression	emergent	55	Category 2	91	Category 3	31.55	50	5.16	43.01	**93.01**
2002	Marie DeLarme Creek	riverine	forest	88	Category 3	67	Category 3	24.33	35.83	3.68	30.68	**66.5**
2002	Meadow Brook	coastal	emergent	50	Category 2	60	Category 2	14.6	11.5	2.59	21.55	**33.05**
2002	Middle Harbor	coastal	emergent	52	Category 2	50	Category 2	13.42	8.55	1.34	11.16	**19.71**
2002	Minkers Run Lower	impoundment	emergent	39	Category 2	68	Category 3	15.46	13.65	2.41	20.05	**33.7**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2002	Minkers Run Upper	impoundment	emergent	47	Category 2	68	Category 3	17.28	18.2	2.01	16.77	**34.97**
2002	Morgan Swamp Beaver	impoundment	emergent	79	Category 3	87	Category 3	22.84	32.1	4.96	41.37	**73.47**
2002	Morgan Swamp Vernal	depression	forest	76	Category 3	84	Category 3	27.55	43.88	5.1	42.5	**86.37**
2002	North Pond Shrub	coastal	shrub	90	Category 3	81	Category 3	18.93	22.33	3.11	25.9	**48.22**
2002	Old Woman West	coastal	shrub	39	Category 2	20	Category 1	13.76	9.4	3.56	29.65	**39.05**
2002	Paine Crossing Forest	riverine	forest	72	Category 3	75	Category 3	19.94	24.85	4.23	35.24	**60.09**
2002	Patton Tract SW Meadow	depression	emergent	75	Category 3	97	Category 3	36.96	50	5.53	46.09	**96.09**
2002	Plum Brook Channel	coastal	emergent	60	Category 3	56	Category 2	10.97	2.43	2.59	21.56	**23.98**
2002	Potters Pond	coastal	emergent	43	Category 2	20	Category 1	13.2	8	0.7	5.83	**13.83**
2002	Raccoon Creek #1	riverine	forest	58	Category 2	61	Category 2	19.86	24.65	4.35	36.22	**60.87**
2002	Raccoon Creek #2	riverine	forest	72	Category 3	56	Category 2	18.34	20.85	4.27	35.61	**56.46**
2002	Redstart	slope	shrub	75	Category 3	70	Category 3	23	32.5	3.68	30.64	**63.14**
2002	Rutherford	impoundment	emergent	52	Category 2	75	Category 3	16.71	16.78	3.57	29.71	**46.49**
2002	Tare Creek Mouth	riverine	emergent	68	Category 3	80	Category 3	18.8	22	3.18	26.48	**48.48**
2002	West St. Marsh	coastal	emergent	36	Category 2	53	Category 2	13.31	8.28	4.79	39.91	**48.18**
2002	Zaleski	riverine	shrub	55	Category 2	39	Category 2	15.5	13.75	5.71	47.58	**61.33**
2002	Zoar Church Rd	riverine	emergent	80.5	Category 3	77	Category 3	23.27	33.18	4.8	39.97	**73.14**
2003	Derby Village	depression	forest	37	Category 2	43	Category 2	16.29	15.73	1.53	12.75	**28.48**
2003	Gott Fen	slope	emergent	80.5	Category 3	94	Category 3	32.95	50	6.77	50	**100**
2003	Irwin Pin Oak	depression	forest	67	Category 3	65	Category 3	30.46	50	4.02	33.47	**83.47**
2003	Mills Campus E	depression	forest	61	Category 3	40	Category 2	21.47	28.68	3.17	26.42	**55.09**
2003	Mills Campus G	depression	forest	61	Category 3	54	Category 2	20.01	25.03	4.14	34.48	**59.51**
2003	Old State Line Rd	depression	forest	61.5	Category 3	54	Category 2	20.71	26.78	4.01	33.4	**60.17**
2003	Owens Fen	slope	emergent	71	Category 3	83	Category 3	37.05	50	5.7	47.53	**97.53**
2003	Pumpkintown Forest	slope	forest	64	Category 3	44	Category 2	23.56	33.9	4.06	33.83	**67.73**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2003	Pumpkintown Oxbow	riverine	forest	80	Category 3	70	Category 3	24.95	37.38	6.13	50	**87.38**
2003	Stillfork Swamp	riverine	emergent	57	Category 2	61	Category 2	17.06	17.65	4.02	33.54	**51.19**
2003	Swan Creek Blue Oxbow	riverine	forest	58	Category 2	57	Category 2	19.4	23.5	4.9	40.83	**64.32**
2003	Swan Creek Green Oxbow	riverine	forest	68	Category 3	43	Category 2	16.67	16.68	5.35	44.61	**61.29**
2003	Upper Cuyahoga Swamp	riverine	emergent	58	Category 2	46	Category 2	12.26	5.65	3.41	28.38	**34.03**
2003	Westerville Marsh	riverine	emergent	64	Category 3	68	Category 3	14.86	12.15	1.68	13.96	**26.11**
2003	Westerville Swamp	depression	forest	39	Category 2	26	Category 2	17.06	17.65	2.85	23.74	**41.39**
2004	BDarby Poland Property	riverine	emergent	70	Category 3	56	Category 2	18.58	21.45	6.24	50	**71.45**
2004	Brukner	slope	emergent	78	Category 3	87	Category 3	29.03	47.58	5.29	44.05	**91.63**
2004	Cedar Pt NE	coastal	emergent	67	Category 3	66	Category 3	22.65	31.63	4.58	38.18	**69.8**
2004	Cedar Pt Swale	coastal	emergent	59	Category 2	43	Category 2	16.77	16.93	2.47	20.55	**37.47**
2004	Cedar Pt West	coastal	emergent	67	Category 3	47	Category 2	16.26	15.65	4.72	39.36	**55.01**
2004	Cowles Cr Swale	coastal	emergent	61	Category 3	57	Category 2	19.15	22.88	2.66	22.18	**45.06**
2004	Gray Farm	slope	forest	65	Category 3	77	Category 3	28.46	46.15	5.13	42.76	**88.91**
2004	King-Dorr Road	depression	forest	70	Category 3	74	Category 3	21.29	28.23	4.39	36.62	**64.84**
2004	LDarby Lake Cr Meadow	riverine	emergent	73	Category 3	68	Category 3	17.89	19.73	4.79	39.95	**59.68**
2004	LDarby Terrace Seep	depression	forest	67	Category 3	68	Category 3	27.35	43.38	3.94	32.81	**76.18**
2004	LDarby Timmons Fen	slope	emergent	77	Category 3	88	Category 3	29.58	48.95	4.99	41.61	**90.56**
2004	MSF CR1D#1	depression	forest	57.5	Category 2	63	Category 3	18.24	20.6	4.6	38.29	**58.89**
2004	MSF CR1D#5	slope	forest	81	Category 3	84	Category 3	22.8	32	4.94	41.17	**73.17**
2004	Muck Farm	depression	emergent	65	Category 3	87	Category 3	25.14	37.85	7.89	50	**87.85**
2004	Ramsar Fen	slope	emergent	61.5	Category 3	70	Category 2	18.54	21.35	2.81	23.43	**44.78**
2004	Slate Run 2004	depression	shrub	76	Category 3	67	Category 3	20.15	25.38	4.12	34.37	**59.75**
2004	Swan Cr Meadow	slope	emergent	67.5	Category 3	84	Category 3	21.77	29.43	3.74	31.15	**60.57**
2004	Wheeler Cr Marsh	coastal	emergent	72	Category 3	71	Category 3	17.45	18.63	2.04	17.04	**35.66**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2004	Wheeler Cr Meadow	coastal	emergent	53	Category 2	32	Category 2	10.19	0.48	2.56	21.32	**21.8**
2004	Wilkins Rd Seep	slope	forest	68	Category 3	83	Category 3	25.94	39.85	5.09	42.44	**82.29**
2005	Alexander Rd	slope	forest	48	Category 2	60	Category 2	16.37	15.93	4.1	34.17	**50.1**
2005	Aquilla Rd	slope	emergent	71	Category 3	84	Category 3	21	27.5	3.42	28.51	**56.01**
2005	Bartholomew Rd	fringing	emergent	52	Category 2	47	Category 2	15.64	14.1	3.95	32.9	**47**
2005	Bath Rd	riverine	forest	49	Category 2	29	Category 2	11.84	4.6	2.03	16.93	**21.53**
2005	Black Rd	depression	emergent	39	Category 2	36	Category 2	11.84	4.6	1.88	15.65	**20.25**
2005	Brecksville	impoundment	forest	49	Category 2	24	Category 1	11.88	4.7	3.14	26.15	**30.85**
2005	Bridge Creek	slope	forest	62	Category 3	43	Category 2	16.89	17.23	1.7	14.14	**31.36**
2005	CVNP Site 007	riverine	emergent	38	Category 2	40	Category 2	10.62	1.55	1.32	10.96	**12.51**
2005	CVNP Site 559	riverine	emergent	34	Category 2	23	Category 1	9.18	0	0.19	1.61	**1.61**
2005	CVNP Site 901	slope	forest	50	Category 2	20	Category 1	9.25	0	1.97	16.4	**16.4**
2005	Goodyear	depression	shrub	76	Category 3	84	Category 3	26.55	41.38	5.43	45.24	**86.61**
2005	Hasbrouck	depression	shrub	77	Category 3	97	Category 3	29.93	49.83	5.64	47.01	**96.84**
2005	Miller	riverine	emergent	48.5	Category 2	54	Category 2	12.22	5.55	3.77	31.38	**36.93**
2005	Oak Knolls	riverine	forest	73	Category 3	69	Category 2	21.54	28.85	3.83	31.89	**60.74**
2005	Old Forge Rd	depression	shrub	75	Category 3	94	Category 3	26.88	42.2	5.53	46.07	**88.27**
2005	Quail Hollow	depression	forest	55	Category 2	50	Category 2	18.34	20.85	2.18	18.15	**39**
2005	Rhinehart	riverine	emergent	67	Category 3	74	Category 2	20.58	26.45	4.63	38.59	**65.04**
2005	South Rider Rd	impoundment	emergent	79	Category 3	91	Category 3	22.91	32.28	3.85	32.05	**64.33**
2005	Thut	depression	forest	71	Category 3	84	Category 3	29.12	47.8	3.96	32.97	**80.77**
2005	Twinsburg	riverine	forest	65	Category 3	74	Category 3	22.31	30.78	3.98	33.15	**63.93**
2005	Wake Robin	depression	forest	73	Category 3	72	Category 3	24.35	35.88	3.44	28.68	**64.56**
2005	Ward Rd	riverine	shrub	61	Category 3	54	Category 2	13.37	8.43	4.11	34.22	**42.65**
2005	Wingfoot Lake	fringing	emergent	51	Category 2	53	Category 2	13.53	8.83	3.31	27.6	**36.42**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2006	Airport Plaza	depression	forest	35	Category 2	39	Category 2	14.12	10.3	3.08	25.65	**35.95**
2006	Alum Creek Dr North	riverine	forest	41	Category 2	27	Category 2	17.24	18.1	2.67	22.26	**40.36**
2006	Alum Creek Dr South	riverine	forest	47	Category 2	43	Category 2	12.07	5.18	1.77	14.72	**19.9**
2006	Antrim Park	riverine	forest	41	Category 2	20	Category 1	14	10	2.22	18.53	**28.53**
2006	ATV	riverine	forest	65	Category 3	58	Category 2	19.98	24.95	3.67	30.58	**55.53**
2006	Barrow Seep 1	slope	forest	70	Category 3	91	Category 3	25.1	37.75	5.53	46.06	**83.81**
2006	Big Walnut Park	riverine	forest	43	Category 2	26	Category 2	15.71	14.28	3.04	25.3	**39.57**
2006	Bolton Field	depression	forest	21	Category 1	10	Category 1	9.98	0	3.45	28.74	**28.74**
2006	Bridgeview	riverine	forest	36	Category 2	27	Category 2	15.77	14.43	1.09	9.12	**23.55**
2006	Cherry Bottom	riverine	forest	35	Category 2	24	Category 1	12.66	6.65	1.04	8.68	**15.33**
2006	Easton	depression	forest	43.5	Category 2	25	Category 2	14.6	11.5	2.14	17.84	**29.34**
2006	Graceland	riverine	forest	36	Category 2	23	Category 1	9.38	0	2.18	18.18	**18.18**
2006	Hill's	depression	forest	64	Category 3	50	Category 2	19.63	24.08	3.05	25.4	**49.48**
2006	ISG151	depression	forest	54	Category 2	60	Category 2	21.55	28.88	3.19	26.6	**55.47**
2006	Ridenour Meadow	slope	emergent	71	Category 3	80	Category 3	20	25	5.38	44.86	**69.86**
2006	Ridenour Oxbow	riverine	emergent	47	Category 2	53	Category 2	15.46	13.65	1.68	13.96	**27.61**
2006	Somerset Park	depression	forest	40	Category 2	43	Category 2	14.62	11.55	3.51	29.23	**40.78**
2006	Sunbury Rd Lower	riverine	emergent	31	Category 2	32	Category 2	10.2	0.5	2.6	21.65	**22.15**
2006	Sunbury Rd Middle	riverine	emergent	60	Category 3	53	Category 2	15.87	14.68	2.69	22.46	**37.13**
2006	Sunbury Rd Upper	riverine	emergent	60	Category 3	49	Category 2	11.21	3.03	1.32	11.02	**14.04**
2006	The Quarry East	fringing	emergent	72	Category 3	67	Category 3	21.81	29.53	3.12	26.01	**55.54**
2006	The Quarry West	slope	forest	46	Category 2	47	Category 2	22.01	30.03	4.8	40.01	**70.03**
2006	Three Creeks Oxbow	riverine	emergent	59	Category 2	22	Category 1	17.24	18.1	1.63	13.58	**31.68**
2006	Towne Centre	depression	forest	30	Category 2	29	Category 2	9.62	0	2.74	22.87	**22.87**
2006	Twigrush	depression	emergent	67	Category 3	87	Category 3	28.6	46.5	5.32	44.35	**90.85**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2006	Watkins Rd North	depression	forest	35	Category 2	26	Category 2	8.96	0	2.9	24.19	**24.19**
2006	Watkins Rd South	depression	forest	35	Category 2	34	Category 2	12.17	5.43	2.95	24.61	**30.04**
2006	Wilson Rd	depression	emergent	29	Category 1	23	Category 1	8.97	0	0.87	7.25	**7.25**
2006	Worthington HS	riverine	forest	44	Category 2	29	Category 2	12.28	5.7	1.86	15.51	**21.21**
2006	Worthington Park	riverine	forest	37	Category 2	19	Category 1	16.25	15.63	1.77	14.79	**30.42**
2008	Asherton Woods	depression	forest	71	Category 3	63	Category 3	20.44	26.1	4.9	40.8	**66.9**
2008	Eastland Mall	depression	emergent	37.5	Category 2	42	Category 2	12.93	7.33	2.07	17.27	**24.6**
2008	Fisher	depression	shrub	82	Category 3	87	Category 3	32	50	4.7	39.21	**89.21**
2008	Graceland 2008	riverine	forest	36	Category 2	24	Category 1	14.39	10.98	1.63	13.62	**24.59**
2008	Keller High 2008	depression	shrub	57.5	Category 2	46	Category 2	18.52	21.3	4.55	37.91	**59.21**
2008	Old Dominion	depression	forest	46.5	Category 2	26	Category 2	13.92	9.8	3.29	27.4	**37.2**
2008	Orndorf	depression	shrub	80	Category 3	74	Category 3	26.24	40.6	4.85	40.42	**81.02**
2008	Sawmill 2008	depression	forest	52	Category 2	47	Category 2	18.76	21.9	3.63	30.29	**52.19**
2008	Spangler Road	depression	forest	34.5	Category 2	16	Category 1	12.57	6.43	1.78	14.8	**21.22**
2008	Venice Club	depression	forest	40	Category 2	42	Category 2	17.77	19.43	3.41	28.4	**47.82**
2008	Watkins Road 2008	depression	forest	35	Category 2	26	Category 2	16.44	16.1	3.15	26.25	**42.35**
2008	Woodmark	depression	forest	58	Category 2	47	Category 2	20.94	27.35	2.59	21.61	**48.96**
2008	Worthington HS 2008	riverine	forest	44	Category 2	21	Category 1	13.55	8.88	1.93	16.12	**24.99**
2009	Alum Creek SP Africa RD Pool 1	depression	forest	76	Category 3	77	Category 3	27.3	43.25	4.51	37.6	**80.84**
2009	Alum Creek SP Beach Pool 1	depression	forest	68	Category 3	67	Category 3	18.8	22	3.92	32.64	**54.64**
2009	Delaware SP Beach 1	depression	forest	59	Category 2	60	Category 2	21.6	29	4.5	37.46	**66.46**
2009	Delaware SP Camp 3	depression	forest	64	Category 3	44	Category 2	19.4	23.5	3.52	29.37	**52.87**
2009	Delaware SP Camp 4	depression	emergent	63	Category 3	67	Category 3	19.6	24	3.87	32.25	**56.25**
2009	Delaware SP Camp 5	depression	shrub	67.5	Category 3	63	Category 3	24.1	35.25	5.78	48.13	**83.38**
2009	Fowler Woods SNP Pool 1	depression	forest	72	Category 3	84	Category 3	24.2	35.5	5.42	45.2	**80.7**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2009	Killdeer Plains WA East 3	depression	forest	66	Category 3	64	Category 3	22.2	30.5	3.89	32.44	**62.94**
2009	Killdeer Plains WA West 2	depression	forest	72	Category 3	60	Category 2	26.2	40.5	2.34	19.5	**60**
2009	Kokosing Wildlife Area 1	depression	forest	70	Category 3	87	Category 3	29	47.5	5.5	45.86	**93.36**
2010	Ashtabula NRDA-1	riverine	emergent	N/A	N/A	37	Category 2	13.2	8	0.81	6.76	**14.76**
2010	Ashtabula NRDA-2	riverine	emergent	N/A	N/A	13	Category 1	10	0	1.03	8.57	**8.57**
2010	Ashtabula NRDA-forested	riverine	forest	N/A	N/A	43	Category 2	19.3	23.25	2.88	23.98	**47.23**
2010	N220-001	riverine	forest	46.5	Category 2	20	Category 1	16.3	15.75	2.73	22.72	**38.46**
2010	N220-003	depression	forest	55	Category 2	51	Category 2	24	35	2.34	19.51	**54.51**
2010	N220-004	depression	forest	67	Category 3	50	Category 2	26.5	41.25	2.88	24.02	**65.27**
2010	N220-005	depression	emergent	25.5	Category 1	20	Category 1	7.5	0	0.38	3.14	**3.14**
2010	N220-010	riverine	forest	71	Category 3	39	Category 2	16.5	16.25	4.1	34.14	**50.39**
2010	N220-018	depression	forest	53	Category 2	46	Category 2	16.8	17	3.06	25.47	**42.47**
2010	N220-021-1	riverine	forest	56.5	Category 2	37	Category 2	17.4	18.5	4.28	35.7	**54.2**
2010	N220-021-2	riverine	forest	56.5	Category 2	24	Category 1	18.5	21.25	1.16	9.7	**30.95**
2010	N220-023	depression	emergent	20	Category 1	23	Category 1	7.8	0	2.76	23.02	**23.02**
2010	N220-027	fringing	emergent	78.5	Category 3	87	Category 3	23.1	32.75	5.69	47.41	**80.16**
2010	Shaker Heights Pre-Condition	riverine	emergent	N/A	N/A	0	Category 1	7.5	0	0.74	6.19	**6.19**
2011	NWCA11-OH-3003_A	impoundment	forest	42	Category 2	41	Category 2	15.7	14.25	1.49	12.4	**26.65**
2011	NWCA11-OH-3003_B	impoundment	forest	42	Category 2	40	Category 2	16.9	17.25	1.73	14.43	**31.68**
2011	NWCA11-OH-3004	depression	shrub	44.5	Category 2	16	Category 1	11.3	3.25	4.44	37.03	**40.28**
2011	NWCA11-OH-3005_A	depression	emergent	31	Category 2	17	Category 1	7.3	0	2.74	22.82	**22.82**
2011	NWCA11-OH-3005_B	depression	emergent	31	Category 2	20	Category 1	8.3	0	2.85	23.76	**23.76**
2011	NWCA11-OH-3006	coastal	emergent	47	Category 2	36	Category 2	13	7.5	5.11	42.6	**50.1**
2011	NWCA11-OH-3014	slope	emergent	76	Category 3	77	Category 3	26.6	41.5	3.03	25.26	**66.76**
2011	NWCA11-OH-3019	depression	shrub	64	Category 3	61	Category 2	19.3	23.25	4.33	36.06	**59.31**

Year	Site	HGM Class	Vegetation Class	ORAM	ORAM Category	VIBI	VIBI Category	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
2011	NWCA11-OH-3020	depression	emergent	21.5	Category 1	13	Category 1	7.6	0	0.24	2.04	**2.04**
2011	NWCA11-OH-3022	riverine	emergent	52.5	Category 2	61	Category 3	20.1	25.25	1.26	10.46	**35.71**
2011	NWCA11-OH-3025	riverine	emergent	40	Category 2	44	Category 2	15.2	13	0.42	3.47	**16.47**
2011	NWCA11-OH-3030	coastal	emergent	29	Category 1	22	Category 1	14.1	10.25	1.04	8.63	**18.88**
2011	NWCA11-OH-3031	impoundment	forest	59.5	Category 2	19	Category 1	17.4	18.5	2.74	22.82	**41.32**
2011	NWCA11-OH-3050	depression	forest	74	Category 3	70	Category 3	21	27.5	4.5	37.53	**65.03**
2011	NWCA11-OH-3057	impoundment	forest	58	Category 2	23	Category 1	23	32.5	2.58	21.53	**54.03**
2011	NWCA11-OH-3080	depression	emergent	54.5	Category 2	71	Category 3	20.8	27	3.45	28.77	**55.77**
2011	NWCA11-R062	depression	shrub	N/A	N/A	56	Category 2	26.5	41.25	3.69	30.77	**72.02**
2011	Shaker Heights NC	riverine	emergent	N/A	N/A	47	Category 2	15.4	13.5	1.34	11.2	**24.7**
2012	NWCA-OH-3044	riverine	emergent	56	Category 2	66	Category 2	21.8	29.5	2.69	22.4	**51.9**
2012	NWCA-OH-3045	riverine	emergent	34	Category 2	64	Category 3	20.1	25.25	2.6	21.67	**46.92**
2012	NWCA-OH-3046	riverine	emergent	81	Category 3	71	Category 3	20.1	25.25	4.35	36.23	**61.48**
2012	NWCA-OH-3062	impoundment	forest	51	Category 2	50	Category 2	24	35	2.47	20.6	**55.6**
2012	NWCA-OH-3063	impoundment	emergent	36	Category 2	23	Category 1	8.5	0	3.24	27.03	**27.03**
2012	NWCA-OH-3066	riverine	forest	83	Category 3	80	Category 3	36.8	50	4.37	36.38	**86.38**
2012	NWCA-OH-3068	depression	emergent	38	Category 2	53	Category 2	7	0	2.14	17.81	**17.81**
2012	NWCA-OH-3072	coastal	emergent	53	Category 2	68	Category 3	17.7	19.25	4.31	35.9	**55.15**
2012	NWCA-OH-3081	riverine	emergent	40	Category 2	23	Category 1	16.6	16.5	1.85	15.46	**31.96**
2012	NWCA-OH-3083	impoundment	emergent	25	Category 1	16	Category 1	9.7	0	1.46	12.19	**12.19**
2012	NWCA-OH-3090	riverine	emergent	58	Category 2	64	Category 2	18.6	21.5	1.93	16.1	**37.6**
2012	NWCA-OH-3097	depression	shrub	52	Category 2	36	Category 2	16.7	16.75	3.53	29.39	**46.14**
2012	NWCA-OH-3100	depression	emergent	52	Category 2	72	Category 2	15.3	13.25	2.92	24.35	**37.6**
2012	NWCA-OH-3104	riverine	emergent	24	Category 1	6	Category 1	9	0	0.83	6.92	**6.92**
2012	NWCA-OH-3106	riverine	forest	69	Category 3	34	Category 2	14.9	12.25	2.79	23.23	**35.48**
2012	NWCA-OH-3132	depression	forest	47	Category 2	33	Category 2	17	17.5	2.2	18.37	**35.87**

Table 4. VIBI and VIBI-FQ data for mitigation wetlands (mitigation banks and permittee-responsible) monitored from 2006 to 2011.

Monitoring Year1	Site Name	Year	VIBI	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
1	Big Darby Hellbranch Mitigation Bank FP-14	2009	54	15.7	14.25	0.41	3.42	**17.67**
2	Big Darby Hellbranch Mitigation Bank FP-14	2010	46	16.3	15.75	1.71	14.28	**30.03**
3	Big Darby Hellbranch Mitigation Bank FP-14	2011	42	16.2	15.5	1.91	15.9	**31.4**
1	Big Darby Hellbranch Mitigation Bank FP-15	2009	45	15.8	14.5	2.13	17.75	**32.25**
2	Big Darby Hellbranch Mitigation Bank FP-15	2010	34	15.3	13.25	1.4	11.67	**24.92**
3	Big Darby Hellbranch Mitigation Bank FP-15	2011	37	17.2	18	1.16	9.7	**27.7**
1	Big Darby Hellbranch Mitigation Bank FP-16	2009	34	8.2	0	1.97	16.45	**16.45**
2	Big Darby Hellbranch Mitigation Bank FP-16	2010	42	13.1	7.75	2.04	16.99	**24.74**
3	Big Darby Hellbranch Mitigation Bank FP-16	2011	23	10	0	1.63	13.56	**13.56**
3	Big Darby-Hellbranch - Aggregate 1 (1, 1N, 1S)	2011	43	13.3	8.25	2.75	22.93	**31.18**
1	Big Darby-Hellbranch - Aggregate 2 (2, 3, 4) Marsh	2009	44	15.5	13.75	1.34	11.2	**24.95**
2	Big Darby-Hellbranch - Aggregate 2 (2, 3, 4) Marsh	2010	29	14	10	1.84	15.37	**25.37**
3	Big Darby-Hellbranch - Aggregate 2 (2, 3, 4) Marsh	2011	27	11.34	3.36	1.79	14.91	**18.27**
1	Big Darby-Hellbranch - Aggregate 3 (5, 12, 13) Marsh	2009	45	14.61	11.52	0.78	6.49	**18.01**
2	Big Darby-Hellbranch - Aggregate 3 (5, 12, 13) Marsh	2010	37	14.5	11.25	1.88	15.63	**26.88**
3	Big Darby-Hellbranch - Aggregate 3 (5, 12, 13) Marsh	2011	40	15.38	13.44	2.46	20.46	**33.9**
1	Big Darby-Hellbranch - Aggregate 4 (6, 8, 9, 11) Wet Meadow	2009	26	10.06	0.16	0.86	7.18	**7.35**
2	Big Darby-Hellbranch - Aggregate 4 (6, 8, 9, 11) Wet Meadow	2010	37	13	7.5	2.42	20.19	**27.69**
3	Big Darby-Hellbranch - Aggregate 4 (6, 8, 9, 11) Wet Meadow	2011	43	10.47	1.17	2.68	22.31	**23.48**
1	Big Darby-Hellbranch - Aggregate 5 (7, 10) Upland	2009	37	11.84	4.59	0.34	2.83	**7.43**
2	Big Darby-Hellbranch - Aggregate 5 (7, 10) Upland	2010	37	14.6	11.5	0.59	4.88	**16.38**
3	Big Darby-Hellbranch - Aggregate 5 (7, 10) Upland	2011	33	13.12	7.8	0.6	4.99	**12.78**
1	BUT-Green Heron ODOT Pooled Wetland Mitigation Site	2006	27	14.6	11.5	1.93	16.05	**27.55**
5	BUT-Green Heron ODOT Pooled Wetland Mitigation Site	2010	29	13.9	9.75	2.76	23	**32.75**
3	Chippewa North- Central B	2010	60	19.1	22.75	3.02	25.16	**47.91**
3	Chippewa North- Central C	2010	63	21.9	29.75	2.33	19.44	**49.19**
3	Chippewa North- North A	2010	20	5.2	0	3	25	**25**
3	Chippewa North- South D	2010	16	6.4	0	2.4	19.98	**19.98**
4	Edison Woods - AA	2010	64	26.9	42.25	2.94	24.51	**66.76**
4	Edison Woods - Fixed Plot 1	2010	65	22.2	30.5	3.89	32.42	**62.92**
4	Edison Woods - Fixed Plot 2	2010	71	20.3	25.75	4.05	33.76	**59.51**
4	Edison Woods - Fixed Plot 3	2010	66	25	37.5	3.14	26.15	**63.65**

Monitoring Year1	Site Name	Year	VIBI	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
4	Edison Woods- AB	2010	61	23.3	33.25	3.11	25.96	**59.21**
4	Edison Woods- BA	2010	67	27.1	42.75	3.87	32.23	**74.98**
4	Edison Woods- BB	2010	67	25.8	39.5	3.52	29.37	**68.87**
4	Edison Woods- CA	2010	64	28.5	46.25	3.22	26.83	**73.08**
4	Edison Woods- CB	2010	66	27	42.5	3.05	25.39	**67.89**
4	Edison Woods- NS Meadow	2010	50	16.5	16.25	1.75	14.57	**30.82**
5	HAN/WAY-30 ODOT Pooled Wetland Mitigation Site	2011	68	16.8	17	4.82	40.16	**57.16**
1	HOC/ATH-33-Happy Hollow Pooled Wetland Mitigation Area, Wetland A	2011	41	15.2	13	1.87	15.61	**28.61**
1	HOC/ATH-33-Happy Hollow Pooled Wetland Mitigation Area, Wetland B	2011	53	19.6	24	2.29	19.07	**43.07**
1	HOC/ATH-33-Happy Hollow Pooled Wetland Mitigation Area, Wetland C	2011	46	16.5	16.25	1.93	16.12	**32.37**
1	HOC/ATH-33-Happy Hollow Pooled Wetland Mitigation Area, Wetland D	2011	26	12.6	6.5	1.93	16.08	**22.58**
1	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 1	2009	30	9	0	2.47	20.55	**20.55**
2	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 1	2010	29	7.8	0	2.18	18.19	**18.19**
3	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 1	2011	26	9.5	0	2.73	22.73	**22.73**
1	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 2	2009	53	14.3	10.75	4.43	36.92	**47.67**
2	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 2	2010	59	11.8	4.5	4.24	35.34	**39.84**
3	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 2	2011	46	12.5	6.25	3.33	27.75	**34**
1	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 3	2009	17	11.5	3.75	1.28	10.64	**14.39**
2	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 3	2010	33	13.5	8.75	3.51	29.27	**38.02**
3	MAH-80 ODOT Pooled Wetland Mitigation Site, Plot 3	2011	13	14.2	10.5	2.39	19.9	**30.4**
1	ODOT Perry 93 FP 1	2007	53	18	20	1.57	13.08	**33.08**
2	ODOT Perry 93 FP 1	2008	64	20.6	26.5	1.69	14.08	**40.58**
3	ODOT Perry 93 FP 1	2009	64	18.8	22	1.49	12.42	**34.42**
4	ODOT Perry 93 FP 1	2010	63	17.4	18.5	1.93	16.08	**34.58**
5	ODOT Perry 93 FP 1	2011	71	20.9	27.25	1.74	14.5	**41.75**
1	Pearson Metro Park FP 21	2008	29	10	0	0.56	4.65	**4.65**
2	Pearson Metro Park FP 21	2009	39	12.2	5.5	0.03	0.23	**5.73**
3	Pearson Metro Park FP 21	2010	50	13.6	9	1.35	11.28	**20.28**
1	Pearson Metro Park FP 22	2008	13	3.3	0	0.89	7.44	**7.44**
2	Pearson Metro Park FP 22	2009	13	5	0	1.01	8.38	**8.38**
3	Pearson Metro Park FP 22	2010	32	10.8	2	2.19	18.24	**20.24**
1	Pearson Metro Park FP 23	2008	13	2.7	0	1.24	10.36	**10.36**
2	Pearson Metro Park FP 23	2009	28	11	2.5	2.27	18.91	**21.41**
3	Pearson Metro Park FP 23	2010	40	14.7	11.75	2.25	18.76	**30.51**

Monitoring Year1	Site Name	Year	VIBI	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
1	Pearson Metro Park FP 24	2008	33	8.5	0	0.36	3.01	**3.01**
2	Pearson Metro Park FP 24	2009	43	12.8	7	0.78	6.52	**13.52**
3	Pearson Metro Park FP 24	2010	47	13.6	9	1.11	9.28	**18.28**
1	Pearson Metro Park FP 25	2008	23	5.9	0	2.67	22.25	**22.25**
2	Pearson Metro Park FP 25	2009	23	12	5	0.58	4.85	**9.85**
3	Pearson Metro Park FP 25	2010	51	18.5	21.25	2.03	16.89	**38.14**
1	Pearson Random Aggregate 1 (Plots 1,3,4,7,8) Wet Meadow	2008	40	12.18	5.45	2.74	22.86	**28.32**
2	Pearson Random Aggregate 1 (Plots 1,3,4,7,8) Wet Meadow	2009	43	12.56	6.39	0.47	3.94	**10.33**
3	Pearson Random Aggregate 1 (Plots 1,3,4,7,8) Wet Meadow	2010	47	16.7	16.75	2.01	16.75	**33.5**
1	Pearson Random Aggregate 2 (Plots 2 and 5) Upland old field	2008	16	8.13	0	0.37	3.04	**3.04**
2	Pearson Random Aggregate 2 (Plots 2 and 5) Upland old field	2009	27	9	0	0.24	2	**2**
3	Pearson Random Aggregate 2 (Plots 2 and 5) Upland old field	2010	36	12.6	6.5	0.75	6.25	**12.75**
1	Pearson Random Aggregate 3 (Plots 6 and 9) Shallow Emergent Marsh	2008	9	7.14	0	0.25	2.11	**2.11**
2	Pearson Random Aggregate 3 (Plots 6 and 9) Shallow Emergent Marsh	2009	36	10.21	0.51	1.24	10.31	**10.82**
3	Pearson Random Aggregate 3 (Plots 6 and 9) Shallow Emergent Marsh	2010	36	16.7	16.75	2.88	24.03	**40.78**
1	Pearson Random Aggregate 4 (Plots 10,11,12,13) Wet meadow/shallow emergent marsh	2008	16	8.16	0	1.56	12.99	**12.99**
2	Pearson Random Aggregate 4 (Plots 10,11,12,13) Wet meadow/shallow emergent marsh	2009	33	11.15	2.87	1	8.31	**11.18**
3	Pearson Random Aggregate 4 (Plots 10,11,12,13) Wet meadow/shallow emergent marsh	2010	43	14.4	11	2.09	17.43	**28.43**
1	Pearson Random Aggregate 5 (14,15,19,20) Wet meadow	2008	24	9.57	0	1.93	16.06	**16.06**
2	Pearson Random Aggregate 5 (14,15,19,20) Wet meadow	2009	32	12.5	6.25	1.48	12.36	**18.61**
3	Pearson Random Aggregate 5 (14,15,19,20) Wet meadow	2010	49	16.1	15.25	1.55	12.94	**28.19**
1	Pearson Random Aggregate 6 (16,17,18) Upland old field	2008	23	10.41	1.02	0.6	5.01	**6.03**
2	Pearson Random Aggregate 6 (16,17,18) Upland old field	2009	54	14.54	11.34	0.66	5.46	**16.8**
3	Pearson Random Aggregate 6 (16,17,18) Upland old field	2010	50	14.1	10.25	0.3	2.52	**12.77**
3	Shamrock Fixed Plot 1	2008	40	21.2	28	1.91	15.9	**43.9**
5	Shamrock Fixed Plot 1	2010	26	22.4	31	1.99	16.61	**47.61**
6	Shamrock Fixed Plot 1	2011	32	18.2	20.5	2.13	17.78	**38.28**
1	Trumbull Creek 2 - Fixed Plot 26	2006	65	19.7	24.25	1.79	14.93	**39.18**
3	Trumbull Creek 2 - Fixed Plot 26	2008	77	22.5	31.25	2.05	17.08	**48.33**
4	Trumbull Creek 2 - Fixed Plot 26	2009	68	20.7	26.75	1.6	13.32	**40.07**
6	Trumbull Creek 2 - Fixed Plot 26	2011	74	22.5	31.25	1.82	15.21	**46.46**
1	Trumbull Creek 2 - Fixed Plot 27	2006	36	15.2	13	0.89	7.45	**20.45**
3	Trumbull Creek 2 - Fixed Plot 27	2008	34	17.8	19.5	0.84	6.99	**26.49**
4	Trumbull Creek 2 - Fixed Plot 27	2009	47	19.5	23.75	1.66	13.85	**37.6**

Monitoring Year1	Site Name	Year	VIBI	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
6	Trumbull Creek 2 - Fixed Plot 27	2011	50	20.6	26.5	1.15	9.55	**36.05**
1	Trumbull Creek 2 - Fixed Plot 28	2006	65	18.1	20.25	2.28	18.99	**39.24**
3	Trumbull Creek 2 - Fixed Plot 28	2008	64	16.5	16.25	2.5	20.83	**37.08**
4	Trumbull Creek 2 - Fixed Plot 28	2009	64	19.3	23.25	1.58	13.19	**36.44**
6	Trumbull Creek 2 - Fixed Plot 28	2011	71	19.4	23.5	1.57	13.11	**36.61**
1	Trumbull Creek 2 - Fixed Plot 29	2006	41	16.9	17.25	1.18	9.81	**27.06**
3	Trumbull Creek 2 - Fixed Plot 29	2008	54	17.8	19.5	1.31	10.94	**30.44**
4	Trumbull Creek 2 - Fixed Plot 29	2009	71	20.4	26	1.9	15.8	**41.8**
6	Trumbull Creek 2 - Fixed Plot 29	2011	71	21	27.5	1.87	15.56	**43.06**
1	Trumbull Creek 2 - Fixed Plot 30	2006	40	11	2.5	3.74	31.18	**33.68**
3	Trumbull Creek 2 - Fixed Plot 30	2008	69	16.7	16.75	2.54	21.18	**37.93**
4	Trumbull Creek 2 - Fixed Plot 30	2009	71	18.3	20.75	3.26	27.16	**47.91**
6	Trumbull Creek 2 - Fixed Plot 30	2011	42	12.3	5.75	3.18	26.48	**32.23**
3	Trumbull Creek RA1 (1,2,3,4) Wet Meadow	2008	74	21.46	28.65	2.39	19.88	**48.52**
4	Trumbull Creek RA1 (1,2,3,4) Wet Meadow	2009	68	20.58	26.44	1.38	11.52	**37.96**
6	Trumbull Creek RA1 (1,2,3,4) Wet Meadow	2011	61	20.09	25.23	1.8	14.97	**40.2**
3	Trumbull Creek RA2 (5,6,13,14,15 - missing 34,35) Wet Meadow	2008	77	23.61	34.03	2.24	18.66	**52.69**
4	Trumbull Creek RA2 (5,6,13,14,15,34,35) Wet Meadow	2009	77	25.43	38.57	2.31	19.26	**57.83**
6	Trumbull Creek RA2 (5,6,13,14,15,34,35) Wet Meadow	2011	75	21.56	28.89	1.84	15.35	**44.24**
3	Trumbull Creek RA3 (8,11,12) Wet Meadow/marsh	2008	71	21.78	29.45	2.59	21.61	**51.07**
4	Trumbull Creek RA3 (8,11,12) Wet Meadow/marsh	2009	85	21.11	27.78	3.84	32.03	**59.81**
6	Trumbull Creek RA3 (8,11,12) Wet Meadow/marsh	2011	72	18.1	20.25	2.16	18.03	**38.29**
3	Trumbull Creek RA4 (17,20) Wet Meadow/Marsh	2008	47	15.92	14.8	1.58	13.17	**27.97**
4	Trumbull Creek RA4 (17,20) Wet Meadow/Marsh	2009	43	18.57	21.41	1.5	12.48	**33.89**
6	Trumbull Creek RA4 (17,20) Wet Meadow/Marsh	2011	54	16.25	15.63	1.1	9.19	**24.82**
3	Trumbull Creek RA5 (21,24,25 -missing 31,32,33) Wet Meadow	2008	71	18.36	20.89	2.74	22.87	**43.77**
4	Trumbull Creek RA5 (21,24,25,31,32,33) Wet Meadow	2009	71	21.49	28.74	1.83	15.25	**43.98**
6	Trumbull Creek RA5 (21,24,25,31,32,33) Wet Meadow	2011	74	19.24	23.1	2.31	19.21	**42.31**
3	Trumbull Creek RA6 (22,25) Scrub/shrub	2008	60	17.4	18.5	2.37	19.72	**38.21**
4	Trumbull Creek RA6 (22,25) Scrub/shrub	2009	54	15.02	12.56	1.61	13.42	**25.98**
6	Trumbull Creek RA6 (22,25) Scrub/shrub	2011	53	15.95	14.87	2.32	19.3	**34.17**
5	Wellington Reservoir - Fixed Plot - East	2011	73	22	30	2.54	21.17	**51.17**
5	Wellington Reservoir - Fixed Plot - WEST	2011	67	18.4	21	3.15	26.26	**47.26**
3	Wellington Reservoir - NED	2009	61	17.6	19	3.13	26.11	**45.11**

Monitoring Year1	Site Name	Year	VIBI	FQAI	FQAI Metric	Weighted CofC	Weighted CofC Metric	VIBI_FQ
5	Wellington Reservoir - NED	2011	88	21.9	29.75	3.7	30.84	**60.59**
3	Wellington Reservoir - NEW	2009	51	18.1	20.25	2.57	21.45	**41.7**
5	Wellington Reservoir - NEW	2011	81	21.6	29	3.4	28.34	**57.34**
3	Wellington Reservoir - South East	2009	54	20.2	25.5	1.75	14.58	**40.08**
5	Wellington Reservoir - South East	2011	87	24.2	35.5	3.14	26.2	**61.7**
3	Wellington Reservoir - WEST	2009	70	19	22.5	2.8	23.35	**45.85**
5	Wellington Reservoir - West	2011	84	24.2	35.5	3.79	31.56	**67.06**
5	White Star EA - North Fixed Plot 1	2009	55	29.6	49	3.09	25.71	**74.71**
5	White Star EA - North Forested	2009	56	21.4	28.5	2.91	24.27	**52.77**
5	White Star EA - South Fixed Plot 2	2009	54	31.3	50	2.97	24.71	**74.71**
5	White Star EA - South Fixed Plot 3	2009	80	31.8	50	3.74	31.2	**81.2**
5	White Star EA- North Shrub/Scrub	2009	66	21.9	29.75	2.74	22.81	**52.56**
5	White Star EA- South Emergent M	2009	81	21.1	27.75	2.32	19.37	**47.12**
5	White Star EA- South Forested D	2009	84	30.1	50	4.38	36.52	**86.52**
5	White Star EA- South Forested T	2009	58	22.2	30.5	2.76	23.01	**53.51**
5	White Star EA- South Forested W	2009	70	28.8	47	4.25	35.43	**82.43**