

APPENDIX N

Methodology for establishing Golf Course Inventory for Pennsylvania and Water Use Estimates.

July 24, 2006

DRBC is assisting Pennsylvania in the development of its State Water Plan. This memo describes the evaluation of Act 220 registration data related to golf course water use and presents a more comprehensive water use inventory for Pennsylvania. This work will be finalized following a discussion with PADEP staff.

Developing a Comprehensive Golf Course Inventory

Act 220 Golf Course registration and water use data were obtained from PADEP via an email from Dave Jostenski, on 5/2/2006. The data were in flat file MS Excel format and contained 541 records. It is understood that these are *approved registrations* and that PADEP may have more information on golf courses. The data were exported to MS Access. Each record represented an individual source (or withdrawal). To determine the number of golf courses, data were grouped by the field WUDS_PRIMARY_FACILITY_ID. This field has a one-to-one relationship with the field PRIMARY_FACILITY_NAME. This analysis indicated that 262 unique golf courses were represented in the data set. The data are plotted in figure 1.

A search for a comprehensive inventory of golf courses in Pennsylvania was undertaken. The data CD's that come with ArcGIS 9.1 contained a national dataset of golf courses. The subset of PA golf courses consisted of 317 records (golf courses). A search of the web returned a number of on-line golf course databases. The website: www.thegolfcourses.net appeared to have the most extensive listing of golf courses. Data related to the golf courses in Pennsylvania were downloaded and compiled in a MS Access database. Data for 678 golf courses in Pennsylvania were obtained from this website. No latitude / longitude data were available directly from the website, but the address of the golf course was available. From this, the golf courses locations were geocoded using ArcGIS. 581 / 678 golf courses were geocoded based on their street address. The remaining 97 were plotted using coordinates based on the center of the golf course's zip code, as the actual address could not be geocoded by GIS. The data are plotted in figure 2.

The two data sets (Act 220 and the web data (hereinafter referred to as TGC data)) were then compared for matching courses. The matching was done using the PRIMARY_FACILITY_NAME field from Act 220 and the GCName field name from TGC data. 258 of the 262 Act 220 golf courses were matched in the TGC data, only four have no match. 421 courses from the TGC data have no matching records in the Act 220 data. There is an unresolved issue related to Hershey Country Club and Hershey Parkview Golf Course. These are two separate golf courses registered under Act 220, however they have been both been matched to GCID 23 with the presumption that they are both part of the 54 hole Hershey Country Club (from TGC data). This issue may require more investigation or local knowledge.

Based on these two data sources, it suggests that there are a total of 683 golf courses in Pennsylvania, although the exact number will always be a moving target due to golf course construction and closings.

Where courses were able to be matched, lat/long data from Act 220 were used as this information is considered the most accurate. The location of the course is plotted based on the first source record returned in the Act 220 dataset (Access query). Note that courses that only had information in the TGC dataset were plotted according to their street address (not water source location) although in most cases this is likely to be good enough to locate the course in the correct pour point. For those courses that are located based on zip code centers, it may be beneficial to find a more exact location following the screening level assessment. Of the 97 TGC courses that were located based on zip code centers, 36 were matched to Act 220 data, therefore in the final estimate of existing golf courses, 61 are plotted based on a zip code center location. The data are plotted in figure 3.

Given that the Act 220 records represent less than 40% of all golf courses state-wide, it is recommended that current water use estimates based on registration data are augmented using the TGC data to determine location. There is no information on water use from the TGC data and there is no information on the number of holes irrigated from the Act 220 registration data. However, the TGC data provides the number of holes per course and therefore, if a suitable relationship between water use per hole can be established based on the Act 220 water use data, it may be possible to estimate water use at the courses that have not registered under Act 220.

Estimating Water Use for Unregistered Golf Courses

The Act 220 registration data were related to the TGC data to indicate how many holes were present at each golf course. With this information, linear regression analysis was performed in order to establish a relationship between water use and the number of holes irrigated. The results of the regression analysis are shown in figures 4, 5 and 6. However, based on these results, it appears that no reliable relationship can be established between water use and holes per golf course (very low r^2 values, <0.1), in order to apply it to golf courses without water use data. This suggests other factors are impacting water use and that the number of holes is not a significant driver of water use, although there is a logical relationship. Possible problems with the analysis are as follows:

- Information on the number of holes was obtained from a separate database to the water use records; there may be a discrepancy between the two datasets.
- Other factors such as ET / precipitation / soils may be significant drivers of water use not considered in this analysis.
- Water use is available from only one year (2003)

DRBC plans to further investigate these and other factors, following discussion with PADEP staff.

Forecasting Water Use

DRBC staff investigated potential drivers for future demand for golf courses by undertaking a literature search and contacting local, state and national agencies involved in the golf course industry.

Limited information was available on national trends in the golf course industry. A study by the Golf Research Group compared two surveys, one conducted in 1989 and a similar study conducted in 2002. The results suggested that although 4,023 new US courses opened between the two survey years, one million fewer golfers played the game at the time of the second survey. From a water use perspective it is the number of courses which drive water use, not golfers, so the trend for courses and therefore water use has been upwards. However, the industry is seeing fewer rounds per course (on average) and lower green fees (on average) and therefore the demand for new courses is likely to diminish.

However, this national survey is not necessarily representative of conditions in Pennsylvania. Several other individuals and organizations were contacted in order to establish a more local picture, however none of these contacts had additional information on forecasting the demand for future golf course.

Contacts:

Stanley Zontec, Mid-Atlantic Director, USGA Green Section, Glen Mills, PA

Golf Course Superintendents Association of America

United States Golf Association

Kevin Donnelly, DE DNREC

Kevin Mayhew, Superintendent, Newark Country Club, DE

The assumption that the location of golf courses can be related to socio-economic factors was investigated by looking at golf course locations relative to median income of households by census block groups. Figure 7 shows the results of this analysis.

Figure 1

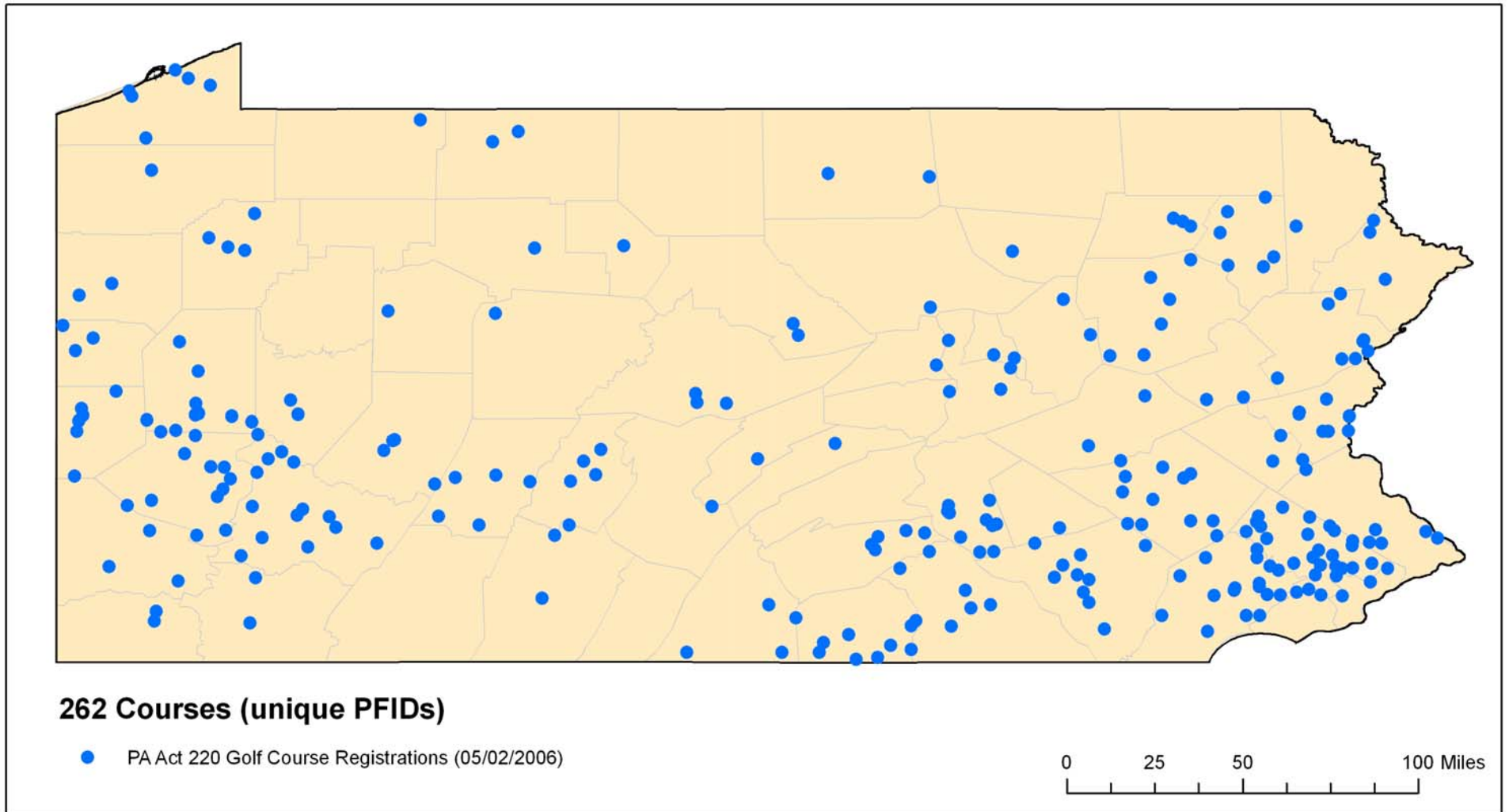


Figure 2

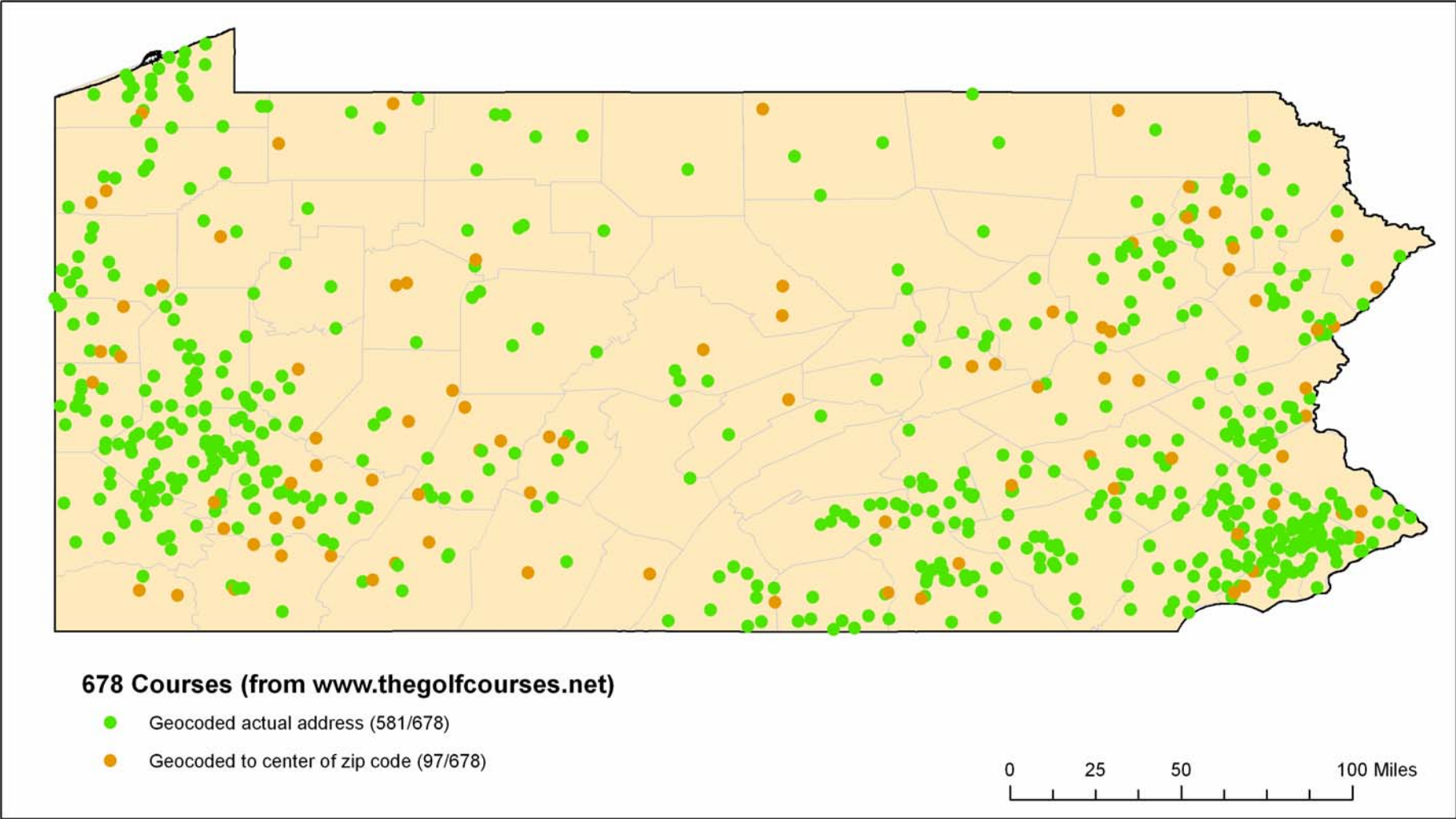
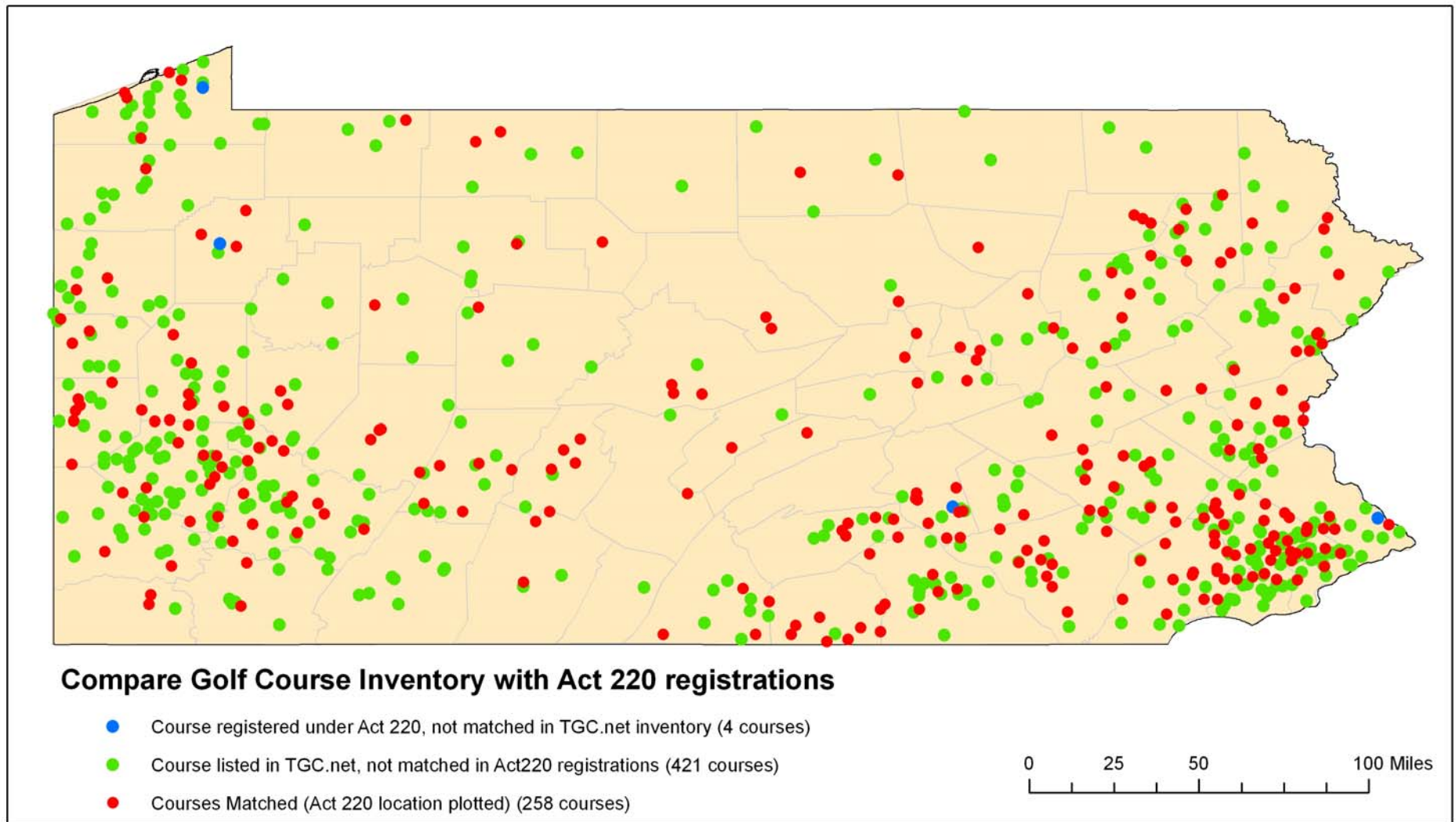


Figure 3



Data Available from www.thegolfcourses.net

Field Name	Description
GCID	Golf Course ID
GCSUBID	Golf Course Sub-ID (for multiple courses)
Link	URL to course description at www.thegolfcourses.net
GCName	Main name of the Golf Course
GCSUBName	Name of particular course (i.e, South Course)
OriginalName	GCName and GCSUBName combined
Type	Private, Public etc
NumHoles	Number of holes at the location (all courses)
Add1	Street Address
Add2	City
Zip	Zip Code
Tel	Telephone number
Fax	Fax number
Twp	Township
YrBuilt	Year the course was built
DesignedBy	Who it was designed by
Greens	Type of grass on the greens
Fairways	Type of grass on the fairways
Comments	Comments

Notes:

GCID 23 is Hershey golf course complex (54 holes). There are two separate WUDS PFID courses that seem to relate to GCID (27420 and 27440). Using the standard relationships these would both match up to 54 holes – but this can't be right. Therefore these have to be dealt with differently in the holes / water use analysis. They are each treated as 18 hole GC's.

Figure 4

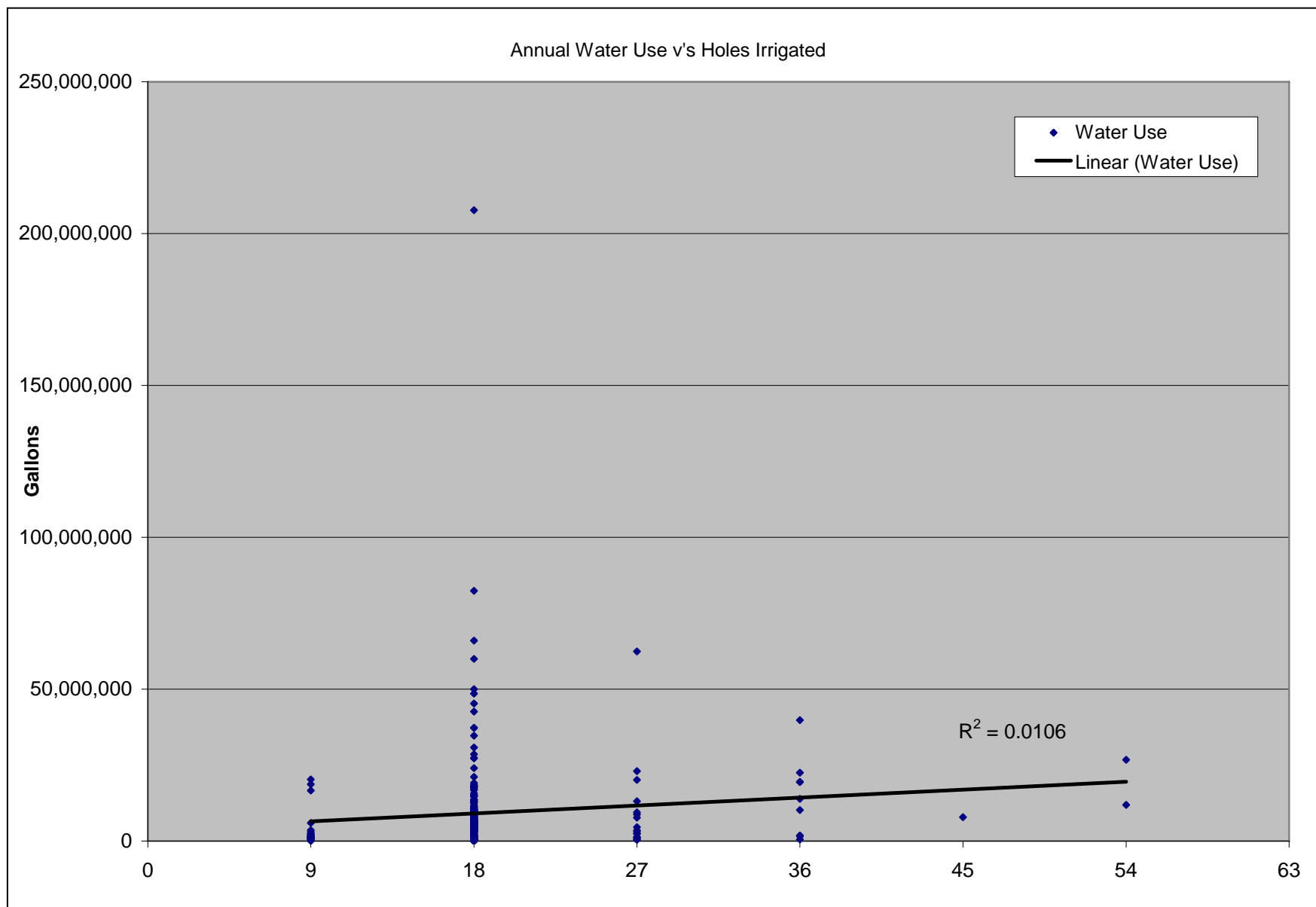


Figure 5

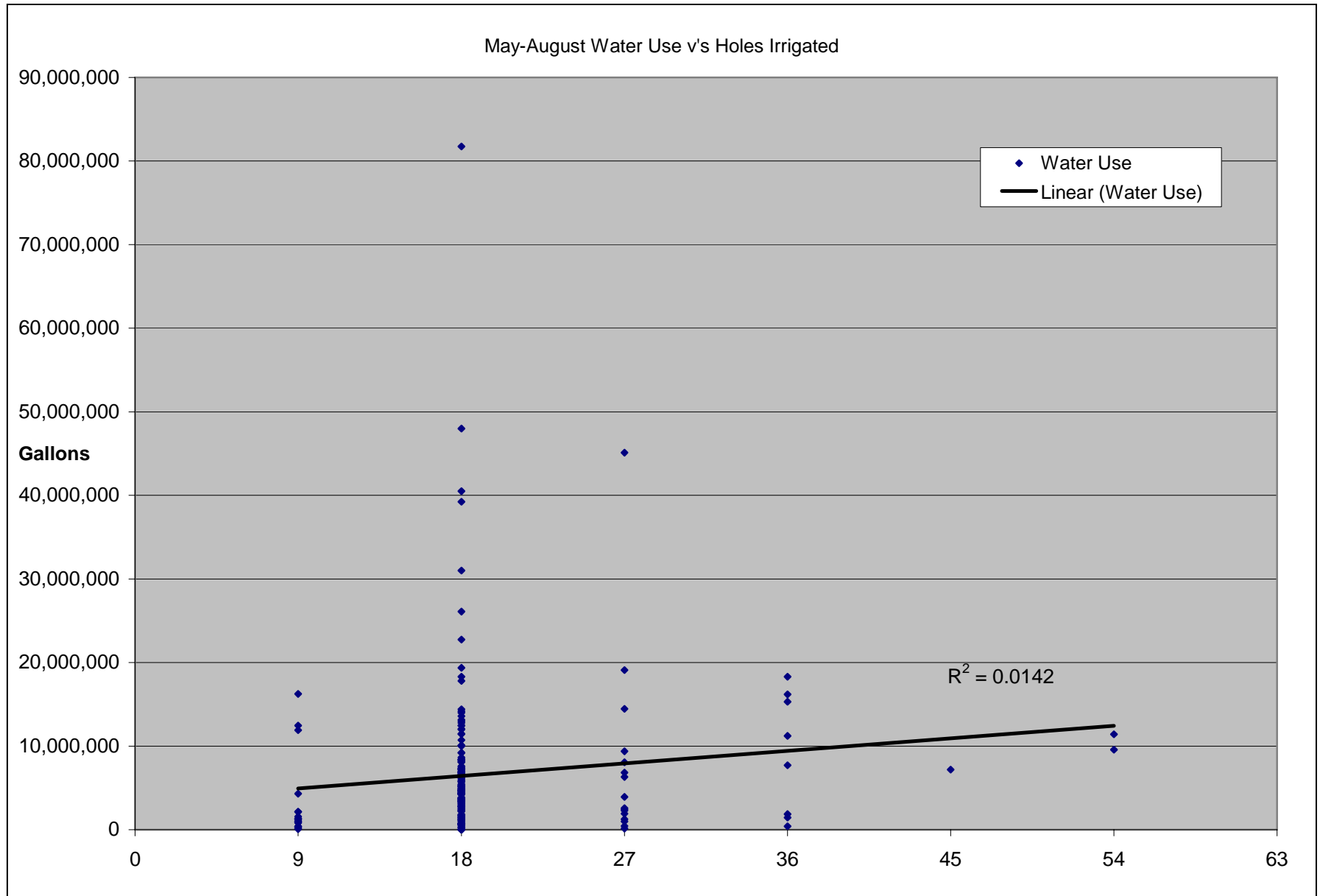


Figure 6

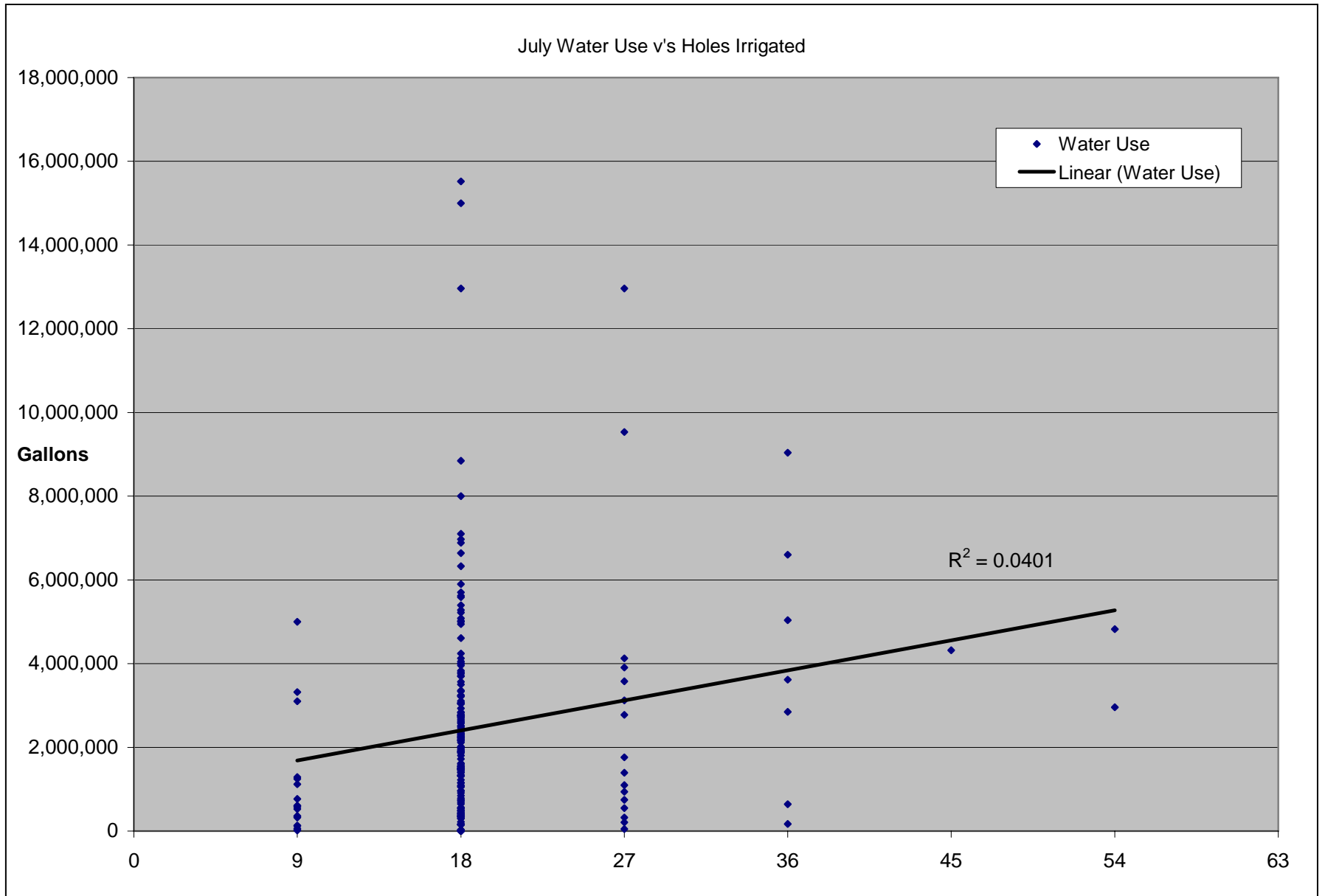


Figure 7

