AGRICULTURE WATER PERMITTING: TURNING REGIONAL PLANS INTO PERMITTING DECISIONS

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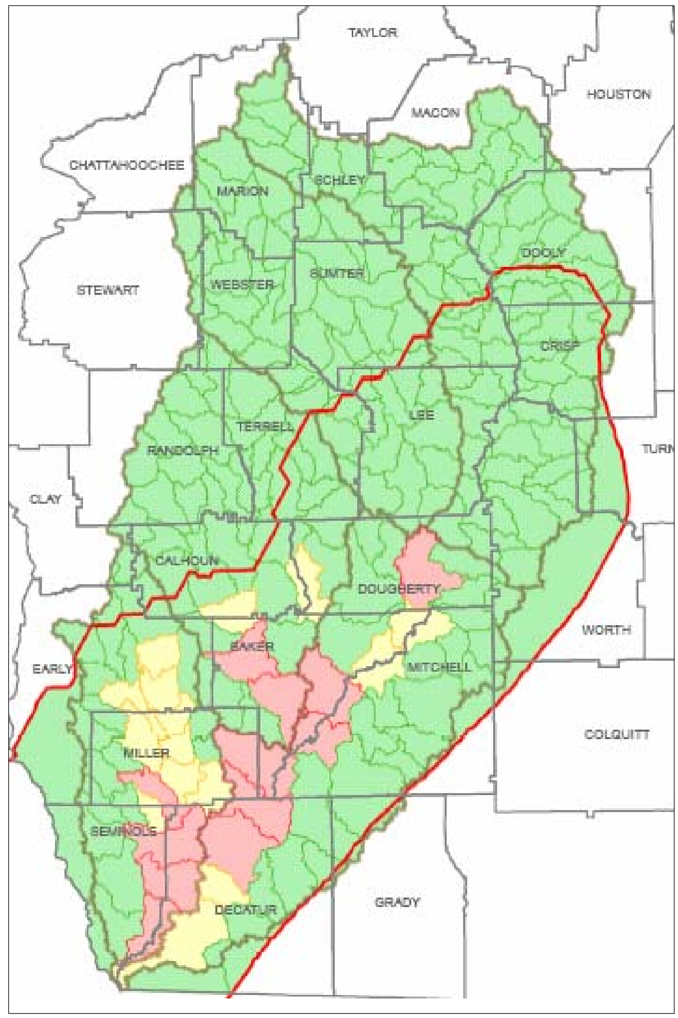
Abstract. During 2006, the Flint River Basin Water Conservation and Development Plan (FRBP) and the Coastal Georgia Water and Wastewater Permitting Plan for Managing Saltwater Intrusion (CZP) were adopted by Georgia Environmental Protection Division. Both had big impacts on permitting of agricultural water withdrawals. Moratoria had been in place postponing new permits. With acceptance of the plans, a flood of backlogged applications, some as old as six years, had to be processed. Permit rule changes in the plans or brought about by concomitant new legislation had to be implemented. The newly formed Agriculture Permitting Unit was relocated to Tifton, and UGA personnel assisted in transforming EPD permitting processes to speed up processing to handle the backlog and implement new regional plans. Existing permits and new applications were incorporated into a geodatabase since most permitting decisions are location specific. GIS tools and models were developed to systematically and objectively evaluate applications, and procedures were established to improve the communication between EPD and agricultural applicants.

BACKGROUND AND PROBLEM

Georgia's recent planning efforts for water use development and water resources protection are exemplified in the two regional plans released in 2006. Creation of the FRBP was precipitated by the rapid growth in agricultural withdrawals in the lower Flint River and ACF Comprehensive Study and models that suggested that the flow in the Flint River could drop to unacceptably low levels in drought years. Given a great deal of uncertainty in the magnitude and extent of agricultural withdrawals, the EPD Director initiated a Regional Water Development and Conservation Plan during 1998. Using provisions within existing permitting laws (O.C.G.A 1205-31(h); O.C.G.A. 12-5-96(e)), the Director imposed a moratorium on new agricultural withdrawal permits in fall of 1999. The order affected proposed withdrawals from Floridan aquifer in sub-area 4 and surface sources throughout the Flint River basin (Fig. 1).



During the lag between initiation of planning and the refusal to accept new applications, EPD received more than 2500 well and surface pump applications. While some provisions were made for permitting of applicants who had already made investments in irrigation, most had to await new studies on agricultural water use, irrigated area, aquifer–stream interactions, ecology of regional streams, and economic impacts of permit restrictions. When the studies were complete, stakeholders, especially farmers, were brought together to develop a plan to carefully develop water use in the basin, while protecting its most threatened streams and habitats.

Problems in the 24 Coastal Zone counties of Georgia emerged as traces of saline water were detected on the rise in coastal cities in South Carolina and Georgia. While the problem affected only the Upper Floridan aquifer in the area, that aquifer was used heavily by industries as well as coastal cities and inland farm areas. In 1997, EPD placed a cap on future withdrawals as part of an interim strategy. They initiated a sound science plan for the area to better define the problem and ordered counties and water users to develop water use plans. As the cap was reached, EPD froze new groundwater applications, but this time it was not only farmers but also municipalities and industries that were affected. As in the Flint Basin, the Coastal Zone plan emerged as a means to examine evidence from the studies and to develop a strategy for cautious water development and conservation that would forever protect the aquifer from salinity problems.

Acceptance of the FRBP and CZP by EPD and the DNR Board, and concomitant legislation that would change conditions on agricultural permits for applications received after April, 2006, freed EPD to begin processing permits in the Flint basin and Coastaal Zone. It also created a severe challenge to the agency's new Agricultural Permitting Unit (APU). Farmers long denied access to the regions water wanted action on all of the backlogged applications. The APU, in turn, had to first develop new procedures to review the 1500+ backlogged FRBP applications and the 350 CZP agricultural well applications, as well as handle new applications under new laws.

The University of Georgia NESPAL offered assistance to EPD to expand the agency's GIS-based permitting system and revamp its procedures to process the large backlog. The effort assisted APU by developing new procedures to accurately locate backlog and new applicant withdrawal points. New location-specific rules and laws initiated by FRBP and CZP efforts were processed through an ArcGIS®-based geodatabase to provide APU hydrologists and geologists accurate and site specific data needed to make permitting decisions. Most importantly, it also assured timely, fair, and consistent evaluation while meeting the regional plan goals.

APPROACH

Three GIS projects were implemented to accomplish the differing needs of planning. These were accurately locating withdrawals, evaluating well applications, and evaluating surface water applications.

GIS Mapping of Applications and Existing Permits

Regional plans created an immediate need for accurately determining where proposed withdrawals would be made. Backlog applications generally lacked specific location data. To get that information a multi-tiered approach was used. For well permit applications that included engineering drawings or farm plans with precise location information (a small minority) and others that had the usual low resolution county map marked with an 'X', a point shape was entered on a data layer of pending applications. Applicants who hadn't provided a drilling location were contacted by APU and asked to provide that information before they would receive further consideration.

Application maps were created for each application with geographic information. These application maps that would also become part of the new permit would define the limits of acceptable drilling or pump locations. Map images of approximately 2 km around the estimated site were placed that on a high-resolution, georectified, color aerial image. These 2005 USDA Farm Service Agency images had been prepared as part of a Natural Resource Conservation Service effort to provide consistent modern imagery for conservation planning. A lettered/numbered grid was placed over the image with the application point centered on the map and geographic coordinates were extracted for use in defining approved drilling or pump locations. Finally, existing and pending surface pumps and wells, streams, and roads were overlaid as familiar references. The composite image was provided to the geologist or hydrologists during application evaluation and printed for mailing with approved applications. The later both limited the drilling or pump location and provided the eventual permittee with a map record to include with the permit. Coordinates of approved drilling locations were included in the Letter of Concurrence to drill (LOC), with a stipulation that drilling was only approved there or within 100 m of that point. Otherwise the applicant had to amend the application with alternate proposed location.

To allow the applicant an opportunity to make corrections on line two systems were tried. One used a Google-Map® extension. When a farmer accessed the online map through an APU website and clicked on the arrow representing his point, the composite image was opened. If a correction was needed, the farmer could contact EPD and provide the correct grid location. The second approach created a web database that a farmer could log onto. When the application number was entered, the composite image appeared and the applicant could enter corrections there to both location and other application information. Additionally, generic grid maps were prepared at the same scale and with the same images minus permit and application points. The 15,000 maps that provided complete Georgia coverage were distributed to county agents and placed online. With the map number and grid values an applicant could inform APU of proposed application plans.

Geoprocessing for Groundwater Applications

Geologic investigations and hydrologic modeling in the Flint River basin formed part of the foundation of the FRBP. They showed that aquifer-stream interactions did not occur uniformly and identified stretches of streams that were strongly impacted by groundwater withdrawals. These areas where high pumping and/or decreased flow in the stream segments were considered “Capacity Use” areas, indicating that only minimal increases in withdrawals could be tolerated, and that efforts should be made to reduce existing withdrawals, especially in drought years. Additional areas with lower groundwater withdrawals or lesser effects on stream flow were identified outside of those reaches. These “Restricted Use” areas could tolerate small numbers of new wells or increased withdrawals, but may soon have to be limited. For the majority of the FRBP area, cumulative drawdown of irrigation and other wells was not severe enough to be a concern or stream flow was not affected by the local groundwater level. Additional wells could be allowed in these area with only minimal water conservation guidelines to be met.

Implementing these FRBP results began with definition of affected areas. Impacted stream stretches and the associated groundwater withdrawal areas were delineated along sub-watershed (HUC12) lines. These are shown on Fig. 1 as red “Capacity Use”, yellow “Restricted Use”, and green “Conservation” areas. With well application locations adequately identified, it was a simple process to determine appropriate restriction area using ‘identify’ functions in GIS.

Besides the withdrawal restriction zones based on stream flow impacts, ecologists worried that wells located too close to stretches of streams with threatened and endangered species would further threaten those streams as a cone of depression under stream could induce additional water loss from the stream. The FRBP identified these significant streams throughout the plan area. Circular influence areas with a 1600 m radius were drawn around proposed well sites. If a critical stream reach fell within the area, the applicant was advised to provide an alternate drilling location before a LOC would be issued.

Finally, stakeholders voiced strong concern about protection of their active wells. They wanted some assurance that new wells wouldn’t reduce the yield of well on which they had relied for years. To protect them, EPD would have to learn exactly where those active withdrawals were being made. Fortunately, most permitted wells and pumps in the FRBP area had been mapped during studies of farm water use that were part of the FRBP sound science plan (Hook et al., 2003). Additionally, Georgia Soil and Water Conservation Commission employees visited these sites and measured geographic coordinates with Global Positioning Sensors (GPS) while evaluating each for placement of meters as required under the 2003 HB 579.

As with critical stream protection, a circle with a 1600 m radius was drawn around proposed drilling locations. When existing farm wells or even proposed wells of other applicants fell within this circle, applicants were urged to reconsider or to select a drilling location safely away from neighbors. In most cases, the size of proposed irrigation systems automatically provided this setback, if applicant’s and neighbor’s wells were placed near the center of their irrigated fields. An additional 1600 m setback was used for community and municipal drinking water supplies.

While the intent of the setback is to keep declines from applicant well cone of depression on neighbors’ wells to less than 5% of the their current water column, the setback provides a reasonable level of protection while requiring minimal geologic and well data. Although cones of depressions tend to be rather flat in the high transmissivity areas of the upper Floridan, a check of typical designs suggested that a 1600 m setback would provide sufficient protection for streams and agricultural wells.

However, GIS tools were created to simplify the job of the geologist in those cases where it was necessary to predict drawdown in nearby wells. A digital elevation model was obtained for the FRBP, and because of recent studies of FRBP, similar digital topographic layers were available for the top and bottom of the Floridan aquifer. Once a drilling location was known, identify functions were used to get elevations of the ground surface, top and bottom of the aquifer, and aquifer thickness. Specific capacity and transmissivity, measured at selected test well sites, were calculated for drilling locations using nearest neighbor distances and root mean square averaging in GIS. These values, as well as applicant well design plans could be used with standard hydrogeological equations to predict drawdown at any distance. Unfortunately, only the Flint currently had aquifer surfaces mapped in digital form, and even for the Flint geologists were unhappy with density of aquifer property measurements. As data improves with inclusion of new geologic observations, and as older paper maps of geologic boundaries and surfaces are digitized, this feature will grow in importance.

Geoprocessing for Surface Water Applications

Direct stream withdrawals have a more significant impact on stream flow than wells where only a portion of the water withdrawn could come from the stream flow losses. As a result, the agricultural surface withdrawal permits have drought plan requirements that require permit holders to monitor stream flow. For most of the state, a low flow equivalent to 7Q10 (seven-day average flow known to occur no more than once in 10 years) or less at the point of withdrawal will require the farmer to stop those irrigation. In the FRBP, ecological studies showed that these flow limits are too low to protect endangered species. As a result, for the Ichawaynotchaway and Spring

Creeks, the low flow limit was increased to 25% of average annual flow (AAD) at the point of the withdrawal.

In August 2006, USGS released a the NHD-Plus data set that contained AAD values computed for outflow from every stream segment in Georgia. Their AAD flow relied upon USGS stream gauging stations and then used both unit area discharge and modeled flow methods to calculate AAD at the outflow of each segment. Stream segments were small enough that they could serve as proxies for flow at proposed withdrawal locations along the entire segment. For streams in Spring and Ichawaynotchaway subbasins, 25% of those values were used as flow protection limits. However, if a farmer provided an engineering design or study that showed the actual catchment area for its withdrawal, the unit area discharge of the segment could be used to compute a smaller low-flow protection limit of the actual catchment.

For areas where 7Q10 was the low-flow limit, the unit area discharges for AAD was used with existing 7Q10 values computed for downstream stations to give 7Q10 for the stream segment of proposed withdrawal. There still remains a discrepancy between data used in the calculations. The 7Q10 values used by EPD are the 1972 and earlier values being are also used for NPDES permits. The 25% AAD values, however, are calculated from stream gauge data through 2004. Post irrigation flows are lower than those prior to 1970 in heavily irrigated basins, and as a result some 25% AAD values are actually lower than pre-irrigation 7Q10 values.

In addition to low flow protection, stream withdrawals must also protect downstream users. In effect this creates a first-in-time prioritization for withdrawals, although the intent is to share water among users along a stream. The implementation of this practice requires that existing surface withdrawal locations must be known accurately enough to know who is downstream and who is withdrawing from the main stem downstream versus its tributaries. Some decision had to be made to determine how far downstream to protect early users; the protection was extended only to the point where another higher or equivalent order stream inters downstream of the proposed location.

GIS tools using recent aerial imagery, new USGS defined flow paths (National Hydrologic Data), and flow quantification by stream segments have enabled EPD to implement the FRBP consistently and objectively. Early in 2006, USGS released a hydrologic coverage of watersheds in Georgia that traced flow lines of individual streams in their catchment areas, creating a connected flow system that could be used to trace upstream or downstream from any point. We were able to use this data set to establish who is located on upstream or downstream segments. To do this meant that existing withdrawal points had to be hydrologicaly attached to these flow lines. Using a GIS tool, each mapped withdrawal point was snapped to its nearest flow line and a hydrojunction created. Likewise the proposed withdrawal location was snapped to the line. ArcHydro tools were then used to trace from that proposed point downstream to the next stream hydrojunction. Withdrawal points located along the way were identified and their withdrawal (pumping) rates extracted from the permit database and provided to the hydrologist.

Implementing the FRBP for surface waters was complicated by the language of the enabling legislation, the Surface Water Control Act of 1972. Withdrawals from "surface waters of the state" in excess of 100,000 gallons per day, on a monthly average, require permits. In its "surface waters of the state" definition, the law specifically excludes those farm ponds whose waters are entirely contained on the property of irrigator. In the most liberal definition any farm pond would qualify as an exemption if the applicant owned the surrounding land. Lake Blackshear on the Flint River, could thus qualify if a private individual owned all the surrounding property. Conversely a small dug pond with no outflow would require a permit if if's shores were shared among neighbors. More conservative interpretations argued that a pond which only used runoff collected during storms, but that otherwise had no outflow, would qualify for an exemption. Conversely ponds which dammed perennial streams or other waterways fed by springs, seepage, and interflow such that they pond had outflow most or all of the year would require a permit.

The farm pond exemption has been variously interpreted by EPD over the years. Generally speaking, they permitted withdrawals from ponds if an application was made, as they had no means to verify if the pond otherwise met the exemption. As a result, more than 10,000 surface water withdrawals for farm ponds have been permitted. For most there is no computer and only scant paper records of catchment areas or pond outflow conditions.

The NHD flow lines and interconnected NHD water bodies were defined as surface waters of the state, whether intermittent or perennial flow. Ponds whose dams intercepted this flow, like direct withdrawals at the same location were considered ponds that needed permits. Low flow limits were defined as pond outflows that needed protection. Where those low flows, either 25% AAD or 7Q10 exceeded 1 cfs, a low flow protection plan was required. Conversely, ponds that sat on drainage ways or dugout areas that were connected with intermittent or perennial flow channels only during runoff events were not considered waters of the state and were not evaluated for or issued LOC's for surface pump installation. Applicants were notified that their withdrawal needed no permit.

SUMMARY

Three GIS projects were implemented to accomplish the differing needs of accurately locating withdrawals, evaluating well applications, and evaluating surface water. Each took aspects of state law, agricultural withdrawal permitting rules of EPD, or EPD-approved plans of the FRBP and used tools in GIS to assist in objective, consistent and rapid evaluation of withdrawal permit applications.

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