Proposed Desired Future Condition(s) for Aquifer(s) in GMA 12

Environmental Stewardship

Environmental Impacts & Considerations Summary

Submitted January 27, 2015

Contact Information

Name: Steve Box, Executive Director

Address: P.O. Box 1423, Bastrop, TX 78602

Phone: 512-300-6609

Email: Steve.Box@att.net

Representing: Environmental Stewardship

Proposed Desired Future Condition(s): Environmental Stewardship has but one interest in this GMA-12 DFC review process; to protect the integrity and functioning of the ecological systems that form the basis of the Colorado and Brazos river basins and the Carrizo-Wilcox and associated aquifers for current and future generations. **In conformance with the Conservation Amendment of the Texas Constitution, it is the duty of the Texas Legislature and Groundwater Conservation Districts to conserve and preserve the natural resources of the state -- our groundwater, our rivers, our springs, and our ecosystems -- by passing laws, rules, and for the purposes of this effort, adopting desired future conditions, that achieve a balance between conservation and development of those resources *in perpetuity*. To protect our aquifers as we found them while respecting the ownership rights of landowners. Though the ability to preserve an aquifer for future generations is not totally in our control -- its rate of replenishment, and its hydrologic characteristics, are largely a function of Mother Nature and must be accepted and respected -- development of an aquifer, and ultimate depletion of an aquifer and/or the surface water and ecosystems which depend on groundwater, *is the voluntary human action in which we are currently engaged*.**

The essence of conservation and preservation of an aquifer resource is that the rate at which we deplete our aquifers must be in balance with the conservation of the aquifer. That the depletion not be driven only by the desire for development, against which we simply wait for damage to the aquifer's sustainability before attempting to bring it back "in balance". Only as a bright "conservation standard" describing a sustainable aquifer is established -- an aquifer that is preserved in perpetuity -- can we then determine how much of that aquifer we can develop in balance with the conservation standard. Conservation and protection of an existing aquifer for the *common good of future generations* must be the priority, not the *development* of an aquifer to satisfy every current and speculated human demand on it. Civilizations that have disappeared have failed to realize this distinction when they exploited natural resources.

ES recommends that the GMA-12 districts debate and adopt its own version of this conservation standard to guide in adopting desired future conditions during this cycle.

Please be as detailed as possible in describing your proposed DFC. Include the quantifiable value and a description of the method for measuring or calculating the value. Attach additional pages as needed.

Aquifer	Proposed DFC and Measuring/Calculating Method
Carrizo Aquifer	ES recommends the Districts re-adopt[1] the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Calvert Bluff Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Simsboro Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Hooper Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Queen City Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Sparta Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Yegua-Jackson Aquifer	ES recommends the Districts re-adopt the currently adopted DFCs unchanged until the GMA-12 GAM improvements have been completed and adopted. The Districts should consider DFCs for the unconfined portions of the aquifer.
Brazos Alluvium Aquifer	ES recommends the Districts develop DFCs after the GMA-12 GAM improvements have been completed and adopted.
Colorado Alluvium Aquifer	ES recommends the Districts develop DFCs after the GMA-12 GAM improvements have been completed and adopted.

[1] ES does not endorse the currently adopted DFCs as being adequately and sustainably protective of the environment and the aquifers, but does recognize that this is the current legal standard and, as such, should not be changed until the GAM has been improved and better data are available on the nine factors for consideration prior to adopting changed DFCs. This footnote reference applies to all aquifers listed in this section.

Consideration of Proposed Desired Future Condition(s)

The Texas Water code requires that the GMA develop DFCs that "provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area." In the space below, or on additional attached pages[2], please provide your considerations with regard to the nine items that must be considered, per the Texas Water Code, for the proposed DFC(s).

CONSIDERATION 1 – "Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another:"

ES Comments: The uses of groundwater covered in the May 28, 2015 presentation by the Consultants was limited to only human uses described and quantified in regional water planning. Natural uses of groundwater include the outflows of groundwater to surface waters and terrestrial environments that rely on groundwater for biological and ecological function.

ES presentation dated June 27, 2014 provided information regarding these critically important relationships. The following is extracted from that presentation:

Groundwater-surface water interaction and exchange are important biologically and ecologically to a sound ecological environment. The Texas Legislature addressed this in Senate Bill 3 that was passed by 80th Session of the Texas State Legislature and signed into Law June 16, 2007. The Texas State Legislature recognized the value of Texas surface waters in Section 1.06. (b) that states: "maintaining the biological soundness of the state's rivers, lakes, bays, and estuaries is of great importance to the public's economic health and general well-being. The legislature encourages voluntary water and land stewardship to benefit the water in the state".

"(c) The legislature has expressly required the commission [TCEQ], while balancing all other public interests to consider and, to the extent practicable, provide for the freshwater inflows and instream flows necessary to maintain the viability of the state's streams, rivers, and bay and estuary systems in the commission's regular granting of permits for the use of state waters."

TCEQ established the Colorado and Lavaca Basins and Matagorda and Lavaca Bays Area Stakeholder Committee (CL BBASC) for the purpose of recommending an environmental flow regime for these rivers and bays. The CL BBASC completed its recommendations report in September 2011 and environmental flow standards were adopted by TCEQ effective August 30, 2012 (Chapter 298, Subchapter D).

TCEQ established the Brazos River and Associated Bay and Estuary System Area Stakeholder Committee (Brazos BBASC) for the purpose of recommending an environmental flow regime for these Brazos Rivers and the Brazos-Colorado Coastal Basin. The Brazos BBASC completed its recommendations report in March 2012 and environmental flow standards were adopted by TCEQ effective March 6, 2014 (Chapter 298, Subchapter D).

[2] ES has provided extensive comments on previous occasions that are documented herein. It is our expectation, in consideration of 36.108(d-3) that these will be included in the explanatory report along with reasons why they were, or were not, incorporated into the desired future conditions. On a practical basis, it would be desirable that these concerns be addressed prior to the deadline for the explanatory report.

- "Environmental flow regime" means a schedule of flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are shown to be adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats in and along the affected water bodies.

As discussed in Consideration 4, empirical data appears to indicate that there is a possible connection between the Colorado River and the Simsboro aquifer, likely in the outcrop region, between Utley an Bastrop, Texas. Should such a connection exist, and if such pumping as has occurred in the Simsboro is causing this segment of the river to be a "losing" segment, the anticipated increase in pumping in this and associated aquifers will likely exacerbate this situation leading to a significant inflow of water from the river into the aquifers. This situation needs to be better understood and managed before changed DFCs are considered and adopted.

The current GMA-12 GAM 1) predicts a trend toward a decline, and potential reversal, in outflows to surface waters and drains (springs), and 2) indicates that a significant quantity of the groundwater pumped comes from a decrease in surface water outflows. Improvements in the GAM, which have been funded, should increase the accuracy and reliability of these predictions to allow for quantification and thereby a better understanding and ability to manage this relationship.

ES recommendation: Natural environmental flow uses of groundwater should be included in Consideration 1 and the impact of declining outflows to surface waters and terrestrial environments should be modeled under Consideration 4, presented to the Districts, and impacts minimized in developing DFCs.

ES further recommends that the currently adopted DFCs remain in effect[3] until 1) the GMA-12 GAM Improvement Project has been completed and adopted, and 2) the impact of proposed pumping on the Colorado and Brazos rivers, tributaries, springs and other surface features can be quantitatively evaluated using GMA outputs that can be relied upon by the consultants and the public.

CONSIDERATION 2 – "The water supply needs and water management strategies included in the state water plan:"

ES comments dated August 6, 2015: These comments focus on the State Water Plan.

- **Export & Environmental Flows:** The presentation on Needs and Strategies on June 25, 2015 presents an incomplete view of the needs and strategies that impinge on the aquifers because 1) exports of water outside the GMA-12 districts are not included in the analysis, and 2) environmental flow needs and requirements within the GMA-12 districts are not included in the analysis.
    - **ES Request:** A report be prepared that tabulates exports of groundwater included in the State Water Plan and supplements the plan with exports that are not included. The impact of such exports on DFCs should be evaluated via the

[3] ES does not endorse the currently adopted DFCs as being adequately and sustainably protective of the environment and the aquifers, but does recognize that this is the current legal standard and, as such, should not be changed until the GAM has been improved and better data are available on the nine factors for consideration prior to adopting changed DFCs. This footnote reference applies to all aquifers listed in this section.

GAM and included in this consideration. The report should be provided to TWDB for consideration in improvements to the Regional Water Planning Process.
    - **ES Request:** A report be prepared that tabulates environmental flow needs for the Colorado and Brazos rivers as adopted by TCEQ. The impact of future inclusion of these flow needs should be evaluated using GAM and WAM analyses and included in this consideration before acceptance of changed DFCs.
- **Energy – Water Nexus:** The greatest growth in water demand for GMA-12, other than export, is steam electric power, yet very little or no strategies are focused on this gap.
    - **ES Request:** To address the energy-water nexus in a way that can be considered in DFC development and reduces overall demand for water for steam electric power production, GMA-12 and District representatives on regional water planning groups are challenged to confront the imbalance between high growth in this sector that is not addressed by significant strategies in regional water plans.
- **Carrizo-Wilcox Aquifer over-pumping indicated:** It is apparent that the Carrizo-Wilcox Aquifer is the only groundwater aquifer that consistently is forecast to have a declining trend in all districts. The consistent declining trend in groundwater production from existing permits and associated infrastructure in the Carrizo-Wilcox Aquifers should be seen as an indicator that the aquifers are forecast to be pumped at an unsustainable rate. To allow ongoing and unsustainable over-pumping will ultimately lead to irreparable damage to the aquifer system.
    - **ES Request:** Determine if the steady decline in the Carrizo-Wilcox Aquifer under the conditions of the existing production infrastructure is an indicator of unsustainable over-production of the aquifer group. Determine the impact of export development and production on the DFCs and sustainability of the aquifer group.
- **Conservation:** It is irresponsible for district's other than Lost Pines to neglect any degree of strategic planning for conservation.
    - **ES recommendation:** ES recommends that all GCDs in GMA-12 require that, within the extent of their legal ability, all water suppliers submit conservation plans that set quantified conservation targets during each decade of the planning period and that the resulting conservation be evaluated relative to the DFCs and included in analysis of this consideration.

CONSIDERATION 3 – "Hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge:"

ES Comments dated May 15, 2015:

- **Full Water Budgets:** ES requested that hydrological conditions information be presented as full water budgets using Bill Hutchinson's format from a presentation to Lost Pines GCD. ES is pleased that GMA-12 fully complied with this request. Having full water budgets helped in the evaluation of where the pumped water is predicted by the GAM to come from. This has demonstrated that the predictions of the GAM are in conflict with hydrologists' claims and stated expectations.

ES Comments dated June 18, 2015: Comments included

- **1-5) comments on specific slides**

- **6) Water Budget Observations based on ES analysis (see attachments to document). The GAM predicts that:**
    - Outflows to surface waters is the single most significant contributing source of water for pumping.
    - Storage changes were the least significant contributor of water for pumping.
    - Vertical leakage from other aquifers into the Simsboro is the second most significant contributing source of groundwater for pumping.
    - Lateral leakage from other districts into the Simsboro in Brazos Valley is significant during the DFC period.
    - Pumping of the Simsboro aquifer by 2070 is estimated to be 244,000 ac-ft per year with the highest pumping in Brazos Valley, Post Oak Savannah, and Lost Pines respectively.
- **Summary of Observation:** The GAM results indicate that the most significant contributor of groundwater for pumping of the Simsboro aquifer are from 1) a reduction in outflows to surface waters, and 2) the flow of groundwater out of other aquifers within the districts. These findings are in conflict with expectations expressed by the consulting hydrologists.
    - **ES recommendation:** The consultants 1) provide explanations that resolve the discrepancies between these findings and their expectations and, 2) provide estimates of the impacts of these discrepancies on the GAM outputs used to define the DFCs.
    - **ES Requests:**
        - Consultants seek assistance from TPWD to better understand environmental impacts related to decreased outflows to surface waters and the terrestrial environment as predicted by the GAM.
        - The Districts ensure that the INTERA improvements to the GAM include adequate scope and funding to ensure the needed tools are available for groundwater-surface water modeling and management.
        - The information requested in March 27, 2015 letter needs to be provided in order to understand and manage potential impacts of vertical leakage on exempt well owners.
        - Consultants run MODFLOW analyses for the Colorado and Brazos rivers and associated tributaries and presented to the Districts as a part of this consideration.

ES Comments dated August 6, 2015: Comments were primarily on the communication between aquifers in the Carrizo-Wilcox Group (Vertical leakage) as follows:

- **Additional information on the communication of aquifers is summarized from the June 27, 2014 presentation as evidence for aquifer communication from the historical literature.**
- **ES Conclusion:** Based on sound science, and the data used to build the GAM used by GMA-12, it is reasonable to conclude that:
    - Water does move between the aquifers of the Carrizo-Wilcox formations on a regional basis.
    - The GAM reasonably estimates the water movement vertically between aquifers.
    - Pumping in the Simsboro Aquifer will induce leakage from the Carrizo, Calvert Bluff and Hooper, and possibly other formations, into the Simsboro.
- ES Recommendation: The GMA-12 Districts consider the Carrizo-Wilcox Aquifer Group as a single communicating aquifer such that the DFCs for the individual aquifers are

combined and evaluated together for purposes of considering the impact of pumping on the aquifers, for management policies and actions necessary to protect against exceedance of the DFCs, and to estimate and minimize impacts of reduced discharges to surface waters, and domestic wells.

CONSIDERATION 4 – "Other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water:"

As stated in the preamble, Environmental Stewardship has but one interest in this GMA-12 DFC review process: to protect the integrity and functioning of the ecological systems that form the basis of the Colorado and Brazos river basins and the Carrizo-Wilcox and associated aquifers for current and future generation. To be specific:

1. ES asserts that the current adopted desired future conditions (DFC) do not take into consideration a "conservation standard". The adopted DFCs were created by a process that did not include a consideration of what amount of pumping could be developed in the GMA-12 while conserving and preserving the aquifers and surface waters of the region for future generations, *in perpetuity*.

a) The essence of conservation and preservation of an aquifer resource is that the rate at which we deplete our aquifers must be in balance with the conservation of the aquifer. That the depletion not be driven only by the desire for development, against which we simply wait for damage to the aquifer's sustainability before attempting to bring it back "in balance". Only as a bright "conservation standard" describing a sustainable aquifer is established -- an aquifer that is preserved in perpetuity -- can we then determine how much of that aquifer we can develop in balance with the conservation standard. Conservation and protection of an existing aquifer for the *common good of future generations* must be the priority, not the *development* of an aquifer to satisfy every current human demand on it. Civilizations that have disappeared have failed to realize this distinction when they exploited natural resources.

b) The Texas Water Development Board (TWDB), in its technical analysis of the appeals by Environmental Stewardship and End Op LLC, presented information that included its "Estimate Maximum Sustainable Pumping" for the Carrizo-Wilcox aquifer that is significantly lower than the modeled available groundwater (MAG) estimated from the DFCs. Whether or not this level of pumping represents a "conservation line" should be the subject of investigation and debate during this consideration.

c) As mandated by the legislature, the TWDB developed and published "Total Estimated Recoverable Storage (TERS)" values for each aquifer. The usefulness of these estimates is a matter of debate, and evidence was presented at the Texas Association of Groundwater Districts' (TAGD) Groundwater Summit that indicates that use of TERS should be considerably limited. Regardless, development of a reliable "conservation standard" should include the balancing of the TERS against the impacts of pumping large quantities of groundwater on surface waters and the terrestrial environment.

ES recommends that the GMA-12 districts debate and adopt its own version of this conservation standard to guide in adopting desired future conditions during this cycle and future review cycles.

2. ES asserts that the historical and recent relationship between the Colorado and Brazos rivers and their associated tributary streams, springs and seeps must be maintained in order to continue the integrity and functioning of the ecological, biological and hydrological interactions between these groundwater and surface water systems, especially during periods of drought when surface-water flows are severely limited due to lack of rainfall and permitted capture.

a) Empirically collected data and information indicate that there is, and has historically been, a significant outflow of groundwater to the Colorado and Brazos river systems causing them to be primarily "gaining" streams. Empirical data collected in the past decade confirms that the current relationship remains primarily the same, though possibly declining.

b) Empirical data appears to indicate that there is a possible connection between the Colorado River and the Simsboro aquifer, likely in the outcrop region, between Utley an Bastrop, Texas. Should such a connection exist, and if such pumping as has occurred in the Simsboro is causing this segment of the river to be a "losing" segment, the anticipated increase in pumping in this and associated aquifers will likely exacerbate this situation leading to a significant inflow of water from the river into the aquifers. This situation needs to be better understood and managed before changed DFCs are considered and adopted.

c) The current GMA-12 GAM 1) predicts a trend toward a decline, and potential reversal, in outflows to surface waters and drains (springs), and 2) indicates that a significant quantity of the groundwater pumped comes from a decrease in surface water outflows. Improvements in the GAM, which have been funded, should increase the accuracy and reliability of these predictions to allow for quantification and thereby a better understanding and ability to manage this relationship.

ES recommends that the currently adopted DFCs remain in effect[4] until 1) the GMA-12 GAM Improvement Project has been completed and adopted, and 2) the impact of proposed pumping on the Colorado and Brazos rivers, tributaries, springs and other surface features can be quantitatively evaluated using GMA outputs that can be relied upon by the consultants and the public.

3. ES is asserts that there is sufficient vertical flow (leakage) between the Carrizo, Calvert Bluff, Simsboro and Hooper aquifers (Carrizo-Wilcox Group) that the anticipated level of long-term pumping in the Simsboro aquifer will have significant impacts on the water table in these, and possibly other aquifer outcrops, leading to dewatering of segments of these near-surface conditions damaging both terrestrial flora and fauna, and also domestic wells. This same relationship exists with the Sparta, Queen City, and Yegua-Jackson minor aquifer.

a) Two endangered and/or environmentally sensitive species have been brought to the attention of the GMA-12 districts; the Houston toad, and "Navasota ladies' tresses" endemic orchid.

b) The current GMA-12 GAM predicts such vertical flows to be a significant source of the groundwater projected to be pumped. See ES comments on hydrological conditions dated June 18, 2015 and ES presentation to GMA-12 dated June 27, 2014.

[4] ES does not endorse the currently adopted DFCs as being adequately and sustainably protective of the environment and the aquifers, but does recognize that this is the current legal standard and, as such, should not be changed until the GAM has been improved and better data are available on the nine factors for consideration prior to adopting changed DFCs. This footnote reference applies to all aquifers listed in this section.

ES recommendation: The GMA-12 Districts consider the Carrizo-Wilcox Aquifer Group as a single communicating aquifer such that the DFCs for the individual aquifers are combined and evaluated together for purposes of considering the impact of pumping on the aquifers, and for management policies and actions necessary to protect against exceedance of the DFCs, to estimate and minimize impacts of reduced discharges to surface waters, and domestic wells.

4. **ES recommendation:** The Colorado River Alluvial minor aquifer be a managed aquifer subject to development and adoption of desired future conditions.

a) Significant pumping that exists in the aquifer, and its interaction with the other major an minor aquifers in GMA-12, brings about a concern for its active management.

ES comments dated September 21, 2015.

- **GMA-12 Groundwater Availability Model:**
  - ES acknowledges that the GMA-12 GAM does not appear to be a sufficient tool to fully model and predict, on a quantitative basis, the impacts of modeled pumping on surface waters and springs at the level needed and requires improvements.
  - ES is pleased that Post Oak Savannah and Brazos Valley GCDs, LCRA and BRA have agreed to fund improvements in the groundwater-surface water capabilities of the model. We appreciate that Lost Pines is providing an in-kind contribution to this work. We hope that this project is completed successfully as envisioned.
  - ES and INTERA have presented a request for funding to the Colorado-Lavaca Basin and Bay Area Stakeholder Committee to provide additional funding to make further improvements to the GAM. This request was adopted by the CL BBASC and approved by the TWDB and is now being contracted.
  - ES asserts that the relationship between groundwater pumping and the impact of that pumping on the rivers and streams, springs and on the lowering of water tables and dewatering of regions of the aquifer will have significant, and, in some cases, perhaps unacceptable impacts on the ecology and biological life in the rivers, streams and springs and on terrestrial life at or near the land surface.
  - **ES recommendation: The GMA-12 Districts develop an understanding of these relationships and give thoughtful consideration during this review cycle to the implications of the trend data that can be derived from modeling and the evidence of impacts from monitoring. That the Districts develop actionable methods of mitigating against such damages in developing and adopting DFCs. It is not sufficient to say *we don't have adequate tools, so we are not going to take serious, and act on, known trends that warn of future dangers*. Uncertainty should weigh in favor of preservation of groundwater, not exploitation.**
- **GMA-12 GAM Development Reports**
  - ES reviewed the publications that report on the development and calibration of the GMA-12 GAM and provided comments on the reports.
  - The authors state that "the purpose of developing the GAM model of the central part of the Carrizo-Wilcox aquifer is to provide a tool for evaluating changes in water level *and stream flow* for various expected or proposed changes in pumping rates and other activities impacting groundwater".
  - ES points out that, though base-flow is a small fraction of total stream flow during normal conditions, base-flow is a significant contributor to total stream flow during drought conditions as were demonstrated in the following section. ES further

points out that the authors of the report and developers of the model, were adequately confident in the model to make trend predictions and, in some cases, provide quantification of their estimates. We see no reason why the same cannot be accomplished with the current modeling being done by the GMA-12 consultants.

- **Remarks on Presentation**
  - **ES Request:** ES requests that the hydrographic separation be prepared as described in the "remarks on presentation" section of the original comments document, present the results to the Districts, and include in this consideration.
  - **ES Request:** ES requests that maps be prepared with 1) this data overlaid on the Geologic Atlas of Texas – Austin Sheet, 2) identify the location of each cell relative to rivers and streams, 3) characterize relative to the conditions indicated in slide 40, and 4) remove troublesome cells from the map to see if meaningful trends become more evident. Present the results to the Districts and include in this consideration.

CONSIDERATION 5 – "The impact on subsidence:"

CONSIDERATION 6 – "Socioeconomic impacts reasonably expected to occur:"

ES comments: The socioeconomic impact analysis were presented by GMA-12 Consultants and the City of Bryan on August 13, 2015 and October 22, 2015. These presentations focused primarily on the impact on receiving regions if the regions did not get the full requested demand for water. None of these focused on the impact on the donor/supply regions that might occur if these regions suffered social and economic impacts as a result of exporting large quantities of water from the regions. As subsequent 5-year DFC review cycles proceed, it is likely that additional new information will be developed that will lead to a better understanding of impacts on the donor/supply communities. As such, the DFCs should not be changed to serve a speculative future demands.

ES recommendation: GMA-12 should have consultants prepared a socioeconomic impact report that includes impacts on the donor/supply region.

CONSIDERATION 7 – "The impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater:"

ES Comments dated August 6, 2015. ES contends that the Conservation Amendment to the Texas Constitution is an important and instructional document in considering the balancing of groundwater production versus conservation. ES contends that the Conservation Amendment requires that the natural water resources (both surface and groundwater) be managed in such a way as to preserve, protect and conserve both water resources for the citizens and state *in perpetuity* while allowing development of these resources for human use to the extent that the conservation objective is not compromised.

- **Continuum of interests:** ES strongly agrees with the continuum of interests where interests rights range from those benefitted by present use of groundwater to those that are benefitted by leaving a significant amount of groundwater in place.

- **Balancing:** ES contends that, in balancing the use of groundwater at the highest practicable level of production, the GMA and districts must also consider the impacts of groundwater withdrawals on surface water interests and rights as codified in statues:
    - Section 36.108(d)
    - Section 36.114(d)(2)
- **Private property rights:** ES contends that the aforementioned sections have a direct impact on interests and rights in private property and the rights of management area landowners, and have a direct impact on the rights of those who have been granted surface water rights that are impacted when water withdrawn from under the ground has a consequential impact on the amount of groundwater that outflows from the aquifers into surface waters that are owned by the State and have previously been allocated for private use. As such, it is proper that the impact on surface water rights be considered under Section 36.10(c)(7).
- **ES Recommendation: The Consultants prepare a report that quantitatively considers the impact of the pumping anticipated under the adopted DFCs on the property (domestic wells) and surface water rights of landowners and surface water right holders as described above. Present the results to the Districts and include in this consideration. Consider ways to avoid or mitigate these impacts in developing DFCs.**

CONSIDERATION 8 – "The feasibility of achieving the desired future condition:"

ES comments dated October 6, 2015:

- **GMA-12 GAM Accuracy:** ES is concerned that adequate consideration is not being given to the range of variation in the GAM relative to many of the uses of the model, and that, in some cases, the model is being relied upon to provide estimates for which the model was not intended. As such, ES requested that a presentation on this topic include a detailed discussion regarding the adequacy or appropriateness of the current GMA-12 GAM in providing accurate predictions regarding each of 13 listed uses of the model. ES further requested that the presentation include a quantitative estimate of the error (predictive uncertainty) associated with each use of the model listed, and uses of water budgets from run PS4 to quantitatively illustrate the accuracy of each use of the mode.
- **Evaluating GAM accuracy in DFCs:** ES is concerned about how variability in GAM accuracy will be used in evaluating feasibility. ES requested that an understanding of how the accuracy of the GAM will be evaluated in consideration of the feasibility of achieving the DFCs by providing answers to the following questions:
    - Is the objective of assessing the feasibility of achieving the adopted or proposed DFCs an appropriate use of the GMA-12 GAM?
    - Is the mathematical method used in the GMA-12 GAM appropriate to address the problem of predicting the feasibility of achieving the DFC?
    - Does the numerical or analytical model simulate the important physical processes, including the groundwater-surface water interactions required by law, needed to adequately represent the GMA-12 aquifers?
    - If not, what available tools are appropriate to achieve the objective?
- **ES Recommendation: ES reiterates the unfilled requests identified above and recommends that the consultants prepare a report on these subjects, present the results to the Districts, and included in this consideration.**

CONSIDERATION 9 – "Any other information relevant to the specific desired future conditions:"

ES comments dated May 15, 2015 as follows:

ES request: ES respectfully requests that other documents provided to GMA-12 prior to this "form" be included in the record and be considered in the nine considerations regarding the current review of the desired future conditions. Specifically citing:

1. ES presentation on June 27, 2014 which included a PowerPoint presentation, list of references, and copies of selected documents, all of which were provided to GMA-12. Key topics covered in presentation include:

- **Empirical data on gain-loss for Colorado and Brazos Rivers**
- **Modeled impacts of groundwater pumping on the rivers, streams and springs**
- **Evidence of communicating sands in Carrizo-Wilcox Aquifer Group**
- **Requests by others for surface water impacts to be included in DFCs**
  - **Texas Parks and Wildlife Department**
  - **Texas Water Project**
  - **Environmental Stewardship (October 30, 2008)**
- **Predicted trends in groundwater-surface water relationship**
  - **Water budget**
  - **Gaining rivers become losing rivers**
  - **Vertical leakage between aquifers**
  - **Impacts on Environmental Flows to rivers and bays.**
  - **Impacts during drought conditions**
- **ES Requests that the following be included in Consideration 4 (Other Environmental Impacts).**
  - **Consider impacts of reduced surface water outflows**
  - **Preserve groundwater-surface water relationship**
  - **Provide for the use adaptive management in the DFC process.**
  - **Set different DFCs for substantially different geographic areas**
    - **Riverine/alluvial regions**
    - **Pinewood forest region**
  - **Install monitoring to detect changes in groundwater-surface water relationships**
  - **Set triggers for actions to mitigate or reduce impacts on rivers, streams and springs**
- **Monitoring tools that have been developed in the basin and elsewhere that can and should be used.**
- **Documents attached to presentation and provided to GMA-12 that should be included in the record:**
  - Exhibit N1-2014: Forestar's Proposal to Pump Groundwater from the Simsboro Aquifer, George Rice, December 14, 2013.
  - Exhibit N2-2014: A Digital Model of the Carrizo-Wilcox Aquifer within the Colorado River Basin of Texas: TWDB Report LP-208, January 1989.
  - Exhibit N3-2014: Ground-water Resources of Bastrop County, Texas. TWDB Report 109, Third printing, November 1981.
  - Exhibit N4-2014: Phase 1 Evaluation Carrizo-Wilcox Aquifer West-Central Study Area Trans-Texas Water Program Draft. LBG-Guyton Associates. January 1994, Published in Volume 2, May 1994.
  - List of documents incorporated by reference from presentation that were provided

to GMA-12 in ES's Petition Appealing the DFCs (June 30, 2011).

2. ES letter and attachments dated March 27, 2015. The letter primarily comments on predictive scenarios PS1-PS4 provided at the February 26, 2015 meeting as revised March 6, 2015 (prior to the nine consideration reviews).
ES requests that these comments be primarily included under considerations 3, 4, and 8.

Key topics covered in letter and attachments include:

- **Trends observed in data**
  - Trend toward violating adopted DFC drawdowns and/or MAGs in one or more aquifers in all Districts
  - MAG exceedances predicted for 4 out of 6 aquifers
  - MAG exceedances for Simsboro aquifer are greater than 50% in 3 out of 5 Districts.
  - Lost Pines and Post Oak Savannah have the greatest divergence in predicted pump age from 2060 to 2070.
  - Drawdown violations are predicted for all aquifers except the Sparta aquifer
  - Drawdown violation of greater than 100 ft are predicted for the Simsboro aquifer in Lost Pines, Post Oak Savannah and Brazos GCDs.
- **ES recommendation: (Conclusion 1):** Considering the trend toward exceeding the DFCs and MAGs, ES recommends that the GMA-12 and Districts RETAIN the currently adopted desired future conditions until such time as a thorough and rigorous study of the aquifers can be done with best available science and full consideration of all the factors required in Section 36.108(d) using the improved GAM as revised and adopted.
- **ES recommendation (Conclusion 2):** The currently adopted DFCs allow the withdrawal of groundwater to a point that would cause unreasonable damage to the terrestrial environment, surface waters (hydrologically and ecologically including environmental flows in the river and into the estuaries), shallow domestic wells, and other social and economic factors. ES recommends that best available science be applied to investigate these factors in order to understand and mitigate the impacts of the currently adopted DFCs before DFCs are changed or revised. That such data and information be applied toward developing DFCs for unconfined segments of the aquifers.
- **ES Recommendation (Conclusion 3):** Since factoring in the MAG should assist accomplishment of the intent that the Districts should issue permits "up to the point that total volume of exempt and permitted production will achieve an applicable DFC," ES recommends establishing an initial DFC that protects and conserves the aquifer should be our highest priority. As an initial step toward this objective, ES recommends the Districts debate and adopt a sustainable conservation standard to guide the adoption of DFCs during this and future review cycles.
- **ES Requests: The following information and data be compiled by the Consultants and presented to the District for consideration in developing DFCs:**
  - New permits since adopted DFCs
  - Registered wells impacted
  - MODFILE extracted on impacts of PS4 pumping on outflows to Colorado and Brazos rivers.
- **ES Requested Actions**
  - GMA-12 Districts research and adopt scientific review and monitoring programs that would enable detection of groundwater-surface water interactions.
  - GMA-12 Districts refrain from voting on potential changes to the currently adopted DFCs until such consideration of factors required by Section 36.108(d) can

be thoroughly evaluated using best available science, including improved GAM model, and reported to the public.

- **Documents attached to letter and provided to GMA-12 that should be included in the record:**
  - Attachment 1: ES DFC and MAG comparison tables.
  - Attachment 2: Colorado River - Simsboro Aquifer Connection.

    Attachment 2A: Saunders, Geoffrey P. February 2006. Low Flow Gain-Loss Study of the Colorado River in Texas. TWDB Report 365, Chapter 19. Table 19-1 with calculations to convert cubic feet per second (cfs) to acre-feet per year.

    Attachment 2B: Saunders, Geoffrey P. February 2009. Low-Flow Gain-Loss Study of the Colorado river in Bastrop County, TWDB Report 374, Chapter 8.

    Attachment 2C: Rice, George. February 2015. Evaluation of Drawdowns Resulting from Baseline Pumping and Potential Pumping from the Simsboro Aquifer in Bastrop and Lee Counties, Texas (Rice Evaluation Report).