Explanatory Report for Adopted Desired Future Conditions of the Fresh Edwards (Balcones Fault Zone) Aquifer in Northern Subdivision, Groundwater Management Area 10

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Abbreviations

ASR	Aquifer Storage & Recovery
BSEACD	Barton Springs/Edwards Aquifer Conservation District
DFC	Desired Future Conditions
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
MAG	Modeled Available Groundwater
TERS	Total Estimated Recoverable Storage
TWDB	Texas Water Development Board

1. Description of Groundwater Management Area 10 and its Northern Subdivision

Groundwater Conservation Districts (GCDs, or districts) were created, typically by legislative action, to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions. The individual GCDs overlying each of the major aquifers or, for some aquifers, their geographic subdivisions were aggregated by the Texas Water Development Board (TWDB) acting under legislative mandate to form Groundwater Management Areas (GMAs). Each GMA is charged with facilitating joint planning efforts for all aquifers wholly or partially within its GMA boundaries that are considered relevant to joint regional planning.

GMA 10 was created to coordinate planning primarily for the San Antonio and Barton Springs segments of the Fresh Edwards (Balcones Fault Zone) Aquifer, but it also includes the underlying down-dip Trinity Aquifer. Other aquifers in GMA 10 include the Leona Gravel, Buda Limestone, Austin Chalk, and the Saline Edwards (Balcones Fault Zone) aquifers. The jurisdiction of GMA 10 includes all or parts of Bexar, Caldwell, Comal, Guadalupe, Hays, Kinney, Medina, Travis, and Uvalde counties (Figure 1). Groundwater Conservation Districts (GCD) in GMA 10 include Barton Springs/Edwards Aquifer Conservation District (BSEACD), Comal Trinity GCD, Edwards Aquifer Authority (EAA), Kinney County GCD, Medina County GCD, Plum Creek Conservation District, and Uvalde County Underground Water Conservation District (UWCD).

As mandated in Texas Water Code § 36.108, districts in a GMA are required to submit Desired Future Conditions (DFCs) of the groundwater resources in their GMA to the executive administrator of the TWDB, unless that aquifer is deemed to be non-relevant for the purposes of joint planning. According to Texas Water Code § 36.108 (d-3), the district representatives shall produce a DFC Explanatory Report for the management area and submit to the TWDB Board a copy of the Explanatory Report.

GMA 10 has designated the fresh Edwards (Balcones Fault Zone) Aquifer in the northern subdivision of the GMA as a major aquifer for purposes of joint planning. The extent of this aquifer-based subdivision corresponds to the Barton Springs segment of the fresh Edwards (Balcones Fault Zone) Aquifer, a TWDB-designated major aquifer system in Texas. This document is the Explanatory Report for the fresh Edwards (Balcones Fault Zone) Aquifer in the northern subdivision within GMA 10.

2. Aquifer Description

For jurisdictional purposes, the northern subdivision of GMA 10 for the fresh Edwards (Balcones Fault Zone) Aquifer is coincident with the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer (Figure 2). The boundaries of the northern subdivision, fresh Edwards (Balcones Fault Zone) Aquifer were determined using the Digital Geologic Atlas of Texas (U.S. Geological Survey and TWDB, 2006) and the GMA 10 boundary. The northern subdivision of GMA 10 for the Edwards (Balcones Fault Zone) Aquifer is located within the Regional Water Planning Areas K and L, and is almost entirely within the BSEACD. The geographic extent of the northern fresh Edwards (Balcones Fault Zone) Aquifer in the BSEACD is presented in Figure 2 (BSEACD website). As illustrated, the jurisdictional area for this aquifer subdivision includes substantial portions of Hays and Travis Counties and a small portion of Caldwell County.

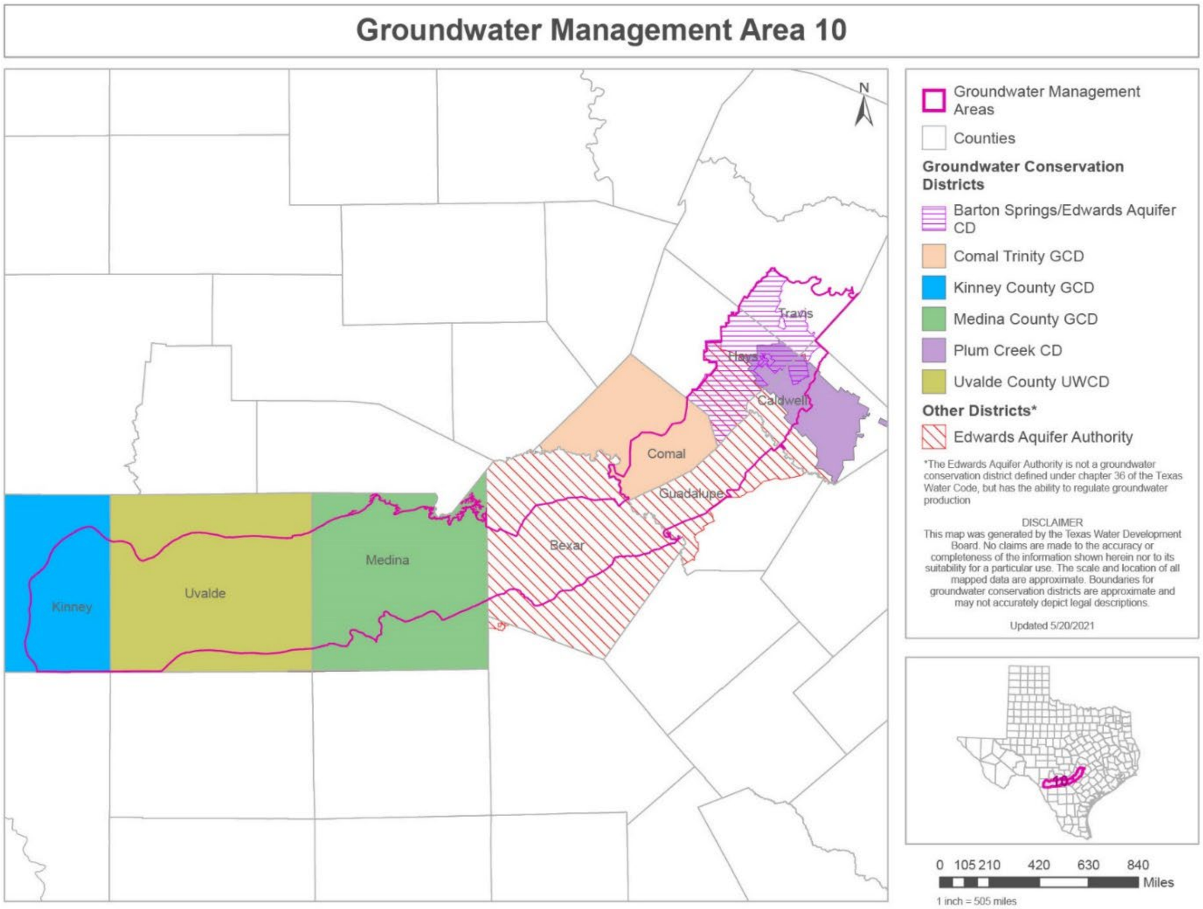

Figure 1. Map of the administrative boundaries of GMA10 designated for joint-planning purposes and the GCDs in the GMA (From Texas Water Development Board website).

3. Desired Future Conditions

GMA10 incorporated information from BSEACD's Management Plan and analyses from the TWDB during development of the proposed DFCs. The DFCs in the first round of joint planning for the northern fresh Edwards (Balcones Fault Zone) Aquifer in Hays and Travis counties in GMA10, were described in Resolution No. 2010-11 and adopted August 23, 2010, by the GCDs in GMA 10.

This subdivision of the aquifer had two DFCs in the first round:

(1) springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cfs averaged over an 84 month (7-year) period; and

(2) springflow of Barton Springs during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, shall be no less than 6.5 cfs averaged on a monthly basis.

The expression of the All Conditions DFC was initially adopted with the intent of providing a limit on the acceleration of the change from non-drought to drought conditions in the aquifer by no more than one month. The expression of the Extreme Drought DFC was initially adopted to preserve a minimum amount of springflow during a recurrence of drought of record conditions.

The third round of DFCs was adopted at the GMA10 meeting on October 26, 2021. GMA 10 has resolved to maintain the same DFCs in the second round as in the first round for this aquifer,and to continue to have two DFCs, related to different water level conditions in the aquifer (Table 1).

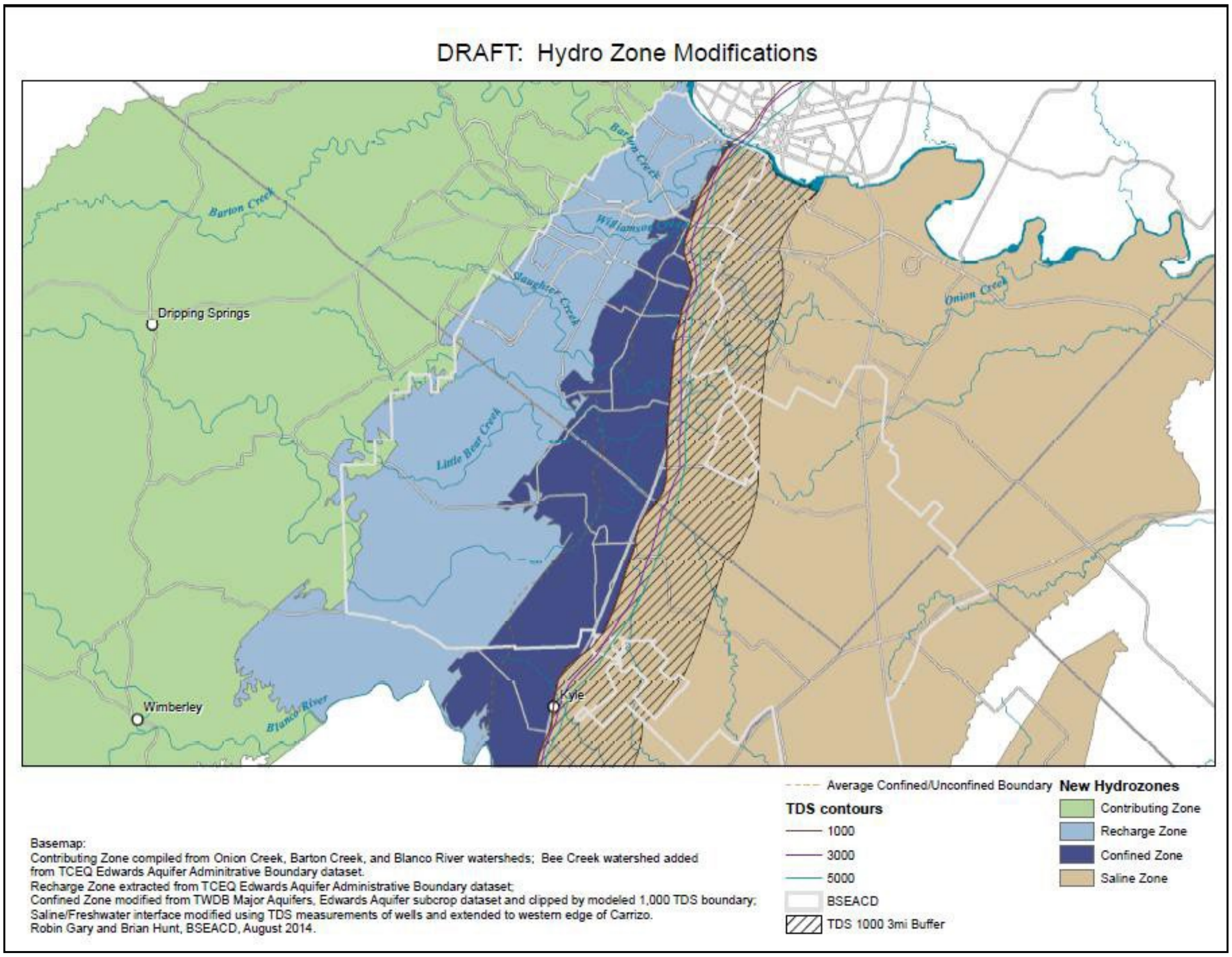

Figure 2. Map showing the extent and hydrologic zones of the Edwards (Balcones Fault Zone) Aquifer in the Barton Springs segment in Hays and Travis counties in Groundwater Management Area 10 (from BSEACD).

Table 1. Desired Future Conditions for the fresh Edwards (Balcones Fault Zone) Aquifer in northern subdivision, Groundwater Management Area 10.

Aquifer	Desired Future Condition Summary	Date Desired Future Condition Adopted
Northern subdivision's fresh Edwards (Balcones Fault Zone) Aquifer	Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cfs averaged over an 84 month (7-year) period; and during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, springflow of Barton Springs shall be no less than 6.5 cfs average on a monthly basis.	First Round: 8/4/2010
Northern subdivision's fresh Edwards (Balcones Fault Zone) Aquifer	Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cfs averaged over an 84 month (7-year) period; and springflow of Barton Springs during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, shall be no less than 6.5 cfs average on a monthly basis.	Second Round: 3/14/2016
Northern subdivision's fresh Edwards (Balcones Fault Zone) Aquifer	Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cfs averaged over an 84 month (7-year) period; and springflow of Barton Springs during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, shall be no less than 6.5 cfs average on a monthly basis.	Third Round:4/20/2021

4. Policy Justification

The DFCs in the northern subdivision of GMA 10 for the fresh Edwards (Balcones Fault Zone) Aquifer in Hays and Travis Counties were adopted after considering the following factors specified in Texas Water Code §36.108 (d):

A. Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another;

   i. for each aquifer, subdivision of an aquifer, or geologic strata; and
   ii. for each geographic area overlying an aquifer

B. The water supply needs and water management strategies included in the state waterplan;

C. 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;

D. Other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;

E. The impact on subsidence;

F. Socioeconomic impacts reasonably expected to occur;

G. 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 asrecognized under Section 36.002;

H. The feasibility of achieving the DFC; and,

I. Any other information relevant to the specific DFCs.

GCDs are required to comply with all federal and state statutes and laws as a matter of law and policy. Two endangered species of salamander have habitat at the Barton Springs outlets of the aquifer; the preservation and health of that habitat depends on maintaining a certain amount of springflow, which is demonstrably affected by groundwater withdrawals by wells. Federal law requires that positive steps be taken to have an approved habitat conservation plan that avoids jeopardy (inability for the endangered species populations to recover) and to minimize take (harm to individuals in the population). BSEACD has finalized a habitat conservation plan and acquiring a federal Incidental Take Permit that will legally allow District-permitted pumping, from the federal prohibition on take, on an exception basis.

These factors and their relevance to establishing the DFCs are discussed in appropriate detail in corresponding subsections within Section 6 of this Explanatory Report.

5. Technical Justification

Technical justification for the DFCs and the subsequent Modeled Available Groundwater in both the first and second rounds of DFCs is summarized in a technical note by Hunt et al. (2011).

There are several numerical models of the Barton Springs segment of the Edwards Aquifer available for simulating aquifer performance and spring discharge. The TWDB-approved Groundwater Availability Model (GAM) for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer was developed by Scanlon et al. in 2001, which incorporated concepts and modeling approaches by earlier researchers (Slade et al., 1986; Barrett and Charbeneau, 1996). This model was calibrated on data from 1989 to 1998 and did not include the historic drought-of-record that lasted from 1950 through 1956, when the estimated minimum monthly discharge of 11 cfs occurred at Barton Springs. Since 2001, there have been several modeling studies to re-calibrate the model to include the drought of record (Smith and Hunt, 2004; Winterle et al., 2009; Hutchison and Hill, 2011) for more confident use in aquifer management and as a Groundwater Availability Model in joint planning. Each of these is described below.

The first Groundwater Availability Model developed for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer (Scanlon et al., 2001) was constructed to match water levels and spring flow from a period wetter than that of the 1950s drought. Because the model was calibrated to a relatively wet period, it overestimates spring flow and under-predicts water- level elevations compared with measurements when simulating the 1950s drought of record. The model was recalibrated by Smith and Hunt (2004) so that simulated and measured spring-flow and water-level data from the 1950s drought matched better. This recalibrated model was accepted by TWDB, and was used as the basis to determine the Modeled Available Groundwater during joint planning in 2010 and during the current cycle of joint planning.

In 2008, the TWDB, in collaboration with BSEACD, contracted with Southwest Research Institute® to develop a groundwater flow model for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer utilizing the MODFLOW-DCM code (Winterle et al., 2009). This model was calibrated based on data from 1989 to 1998. This model is referred to as the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer MODFLOW-DCM model and is considered an alternative Groundwater Availability Model for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer. The 2001 Groundwater Availability Model (Scanlon et al., 2001) was more recently recalibrated by Hutchison and Hill (2011) for the period January 1943 to December 2004. This Groundwater Availability Model is also considered an alternative Groundwater Availability Model.

Evaluation of the various model results during the drought of record indicated that water levels and spring discharge are significantly impacted by 1950s drought conditions and increasing levels of pumping. The models show nearly a one-to-one relationship between pumping increases and spring discharge decreases during low-flow conditions. Hunt et al. (2011) determined that for a total water budget of 11.7 cfs, springflow is simulated at 11 cfs for pumping of 0.7 cfs. This relationship, which has become a key tenet of this aquifer's conceptualmodel and extreme-drought management, is graphically illustrated in Figures 3 and 4 (Hunt et al., 2011).

Since exempt uses are not metered, unlike permitted (non-exempt) uses, pumping data for exempt wells are not available. It is necessary to account for pumping by exempt wells by alternate means when using the Modeled Available Groundwater to determine non-exempt groundwater availability. To do this, the TWDB developed a standardized method for estimating exempt use for domestic and livestock purposes in an area based on projected changes in population and the ratio of domestic and livestock wells to the total number of wells. If a district believes it has a more appropriate estimate of exempt pumping, it may submit the estimate, along with a description of how it was developed, to the TWDB for consideration. BSEACD developed a GIS-based analysis of exempt use for its relatively small geographic area, for which the TWDB method was not readily applicable. The TWDB accepted the District's estimate of exempt use for this aquifer subdivision. Pumping for exempt uses was estimated using the District's alternative method to be 0.5 cfs (361 acre- ft/yr) in the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer (Hunt et al. 2011). Once established, the estimates of exempt pumping were subtracted from the total pumping calculation to yield the portion of the estimated Modeled Available Groundwater foruses under permits.

Although the official and alternate Groundwater Availability Models (Scanlon et al., 2001; Smith and Hunt, 2004; Hutchison and Hill, 2011) were used to confirm a reasonable water budget for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer for the 1950s drought of record, the Modeled Available Groundwater was actually based on this water budget rather than model simulations.

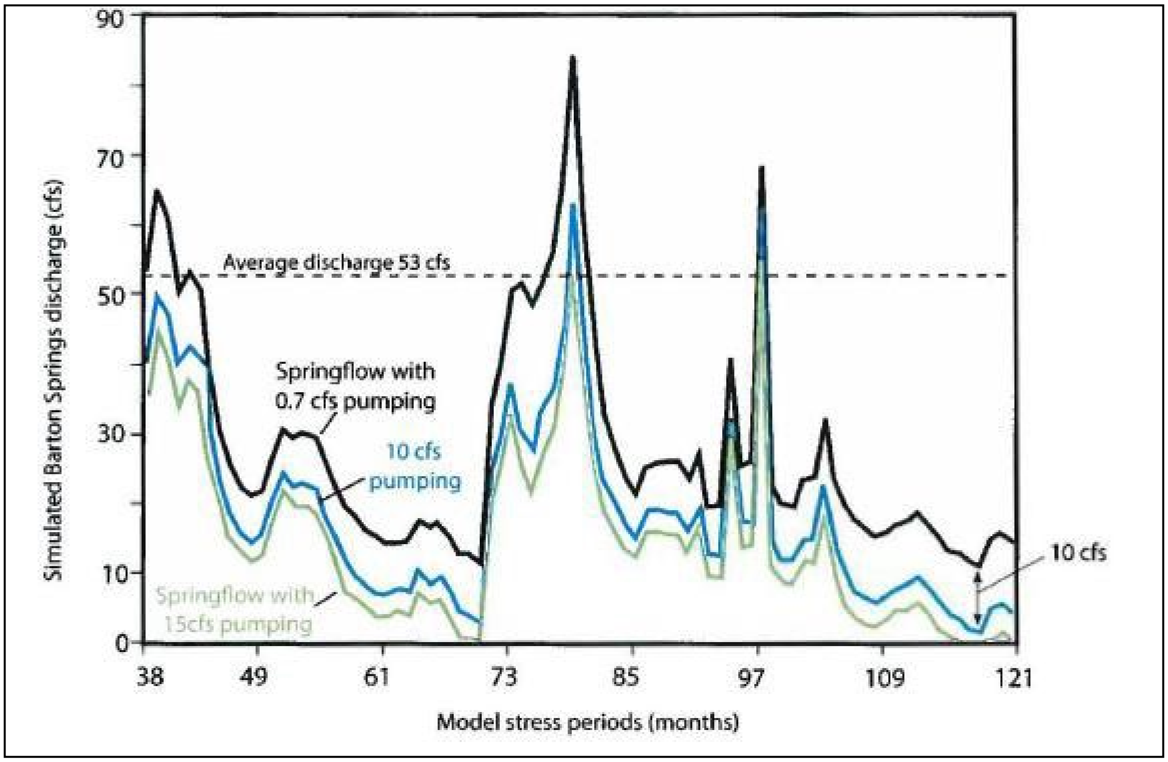

Figure 3. Hydrograph of simulated springflow during the drought of record conditions with variable pumping rates (0.7, 10, and 15 cfs). An increase of pumping from 0.7 to 10 cfs results in a decline in springflow of the same amount. Figure from Hunt et al. (2011).

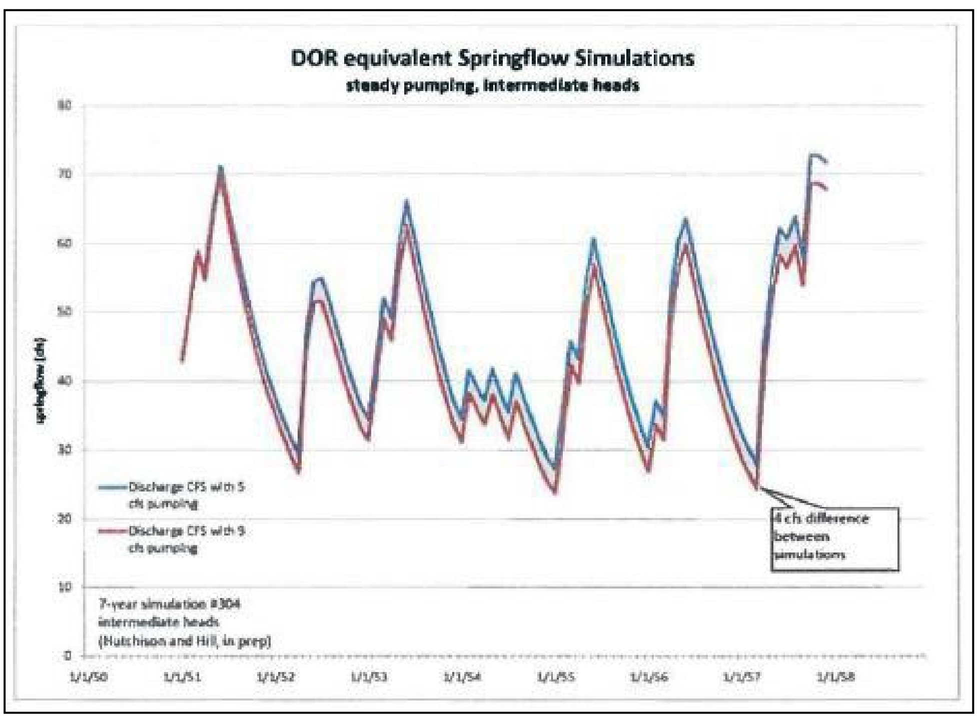

Figure 4. Hydrograph of springflow from two simulations in which pumping that differs by 4 cfs results in spring discharge that differs by 4 cfs (Hunt el al., 2011).

The water budget for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer for the 1950s drought of record is calculated by adding the lowest springflow during the drought of record (11 cfs) to the estimated pumping during the drought of record (0.7 cfs) to provide the total discharge from the aquifer at that time (11.7 cfs). To arrive at the estimated Modeled Available Groundwater, the one-to-one correspondence between pumping and spring discharge is used to justify subtracting DFC spring discharge from the water budget of 11.7 cfs, as shown in in Table 2. The DFC of 6.5 cfs of minimum spring discharge plus the estimated amount of current exempt use of 0.5 cfs are subtracted from the total water budget calculated above to yieldan amount of 4.7 cfs available for non-exempt withdrawals during a recurrence of the drought- of-record (Hunt el al., 2011). Hunt et al. (2011) noted that the water-budget approach reflected inTable 2 is conservative, but prudent given current available data. The water budget, and hence the Modeled Available Groundwater estimates, may be revisited should the influences of urban recharge, the dynamic southern boundary, and climate change be better understood and quantified.

Table 2. Calculations of drought Modeled Available Groundwater (MAG) by decade using water-budget approach (Hunt et al., 2011). **Numbers for 2070 are expected to be the same based on this modeling approach.

	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2070****
Total Water Budget in cfs (acre-ft/yr)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)	11.7 (8,470)
Desired Future Condition in cfs (acre-ft/yr)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)	6.5 (4,705)
Modeled Available Groundwater in cfs (acre-ft/year)	5.2 (3,765)	5.2 (3,765)	5.2 (3,765)	5.2 (3,765)	5.2 (3,765)	5.2 (3,765)	5.2 (3,765)
Exempt Pumping in cfs (acre-ft/yr)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)	0.5 (361)
Non-Exempt Pumping cfs (acre-ft/yr)	4.7 (3,402)	4.7 (3,402)	4.7 (3,402)	4.7 (3,402)	4.7 (3,402)	4.7 (3,402)	4.7 (3,402)

6. Consideration of Designated Factors

In accordance with Texas Water Code § 36.108 (d-3), the district representatives shall produce a Desired Future Condition Explanatory Report. The report must include documentation of how nine factors (See section 4, "Policy Justification" above) identified in Texas Water Code §36.108(d) were considered prior to proposing a DFC, and how the proposed DFC impacts each factor. The following sections of the Explanatory Report summarize the information that the GCDs used in their deliberations and discussions.

6.1 Aquifer Uses or Conditions

6.1.1 Description of Factors in the Northern Subdivision, GMA 10

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018). Groundwater use within BSEACD is comprised primarily of pumpage from the freshwater Edwards (Balcones Fault Zone) Aquifer with a small but increasing component of pumpage from the Trinity Aquifer. An incidental amount of groundwater is derived from the Taylor and Austin Groups and more geologically recent alluvial deposits. These withdrawals, however, are largely from exempt wells and are not permitted.

Given the current BSEACD management scheme of conditional permitting and the drought restrictions and curtailment requirements associated with mandatory interruptible-supply for new pumpage authorizations for the freshwater Edwards (Balcones Fault Zone) Aquifer, it is likely that future groundwater production will trend more towards pumpage from the Middle and Lower Trinity Aquifers and, eventually, the Saline Edwards (Balcones Fault Zone) Aquifer.

Data presented in Table 3 are a compilation of BSEACD's monthly meter readings reported by BSEACD permittees and are therefore, a more accurate representation of actual District groundwater use than estimates provided by the TWDB (http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp). The reported use data are organized by Major Aquifer and Water Use Type (using BSEACD's water-use type designations) in Table 3. These data include neither Exempt Use, which is primarily from the Edwards (Balcones Fault Zone) Aquifer and is estimated to be about 105,000,000 gallons (322.2 acre-ft) annually, nor Non-exempt Domestic Use under the District's Non-exempt Domestic Use general permit, which is also primarily from the Edwards (Balcones Fault Zone) Aquifer and is estimated to be about 20,600,000 gallons (63.2 acre-ft) annually.

Table 3. Type of use of the Edwards (Balcones Fault Zone) Aquifer in BSEACD for the years 2007–2020 (in gallons and acre-ft).

	Public Water System	Commercial	Irrigation	Industrial	Totals
2007	1,237,098,520	9,157,492	90,327,219	145,977,492	1,482,560,723
	3,797	28	277	448	4,550
2008	1,635,001,051	8,129,101	95,486,300	223,125,231	1,961,741,683
	5,018	25	293	685	6,020
2009	1,334,838,604	6,858,106	81,294,200	174,509,965	1,597,500,875
	4,096	21	249	536	4,903
2010	1,398,211,160	8,565,229	91,338,590	240,230,719	1,738,345,698
	4,291	26	280	737	5,335
2011	1,647,368,453	8,791,848	104,405,640	261,507,704	2,022,073,645
	5,056	27	320	803	6,206
2012	1,373,336,830	35,671,087	178,355,433	160,519,889	1,747,883,239
	4,215	109	547	493	5,364
2013	1,265,787,003	32,877,585	164,387,923	147,949,130	1,611,001,641
	3,885	101	504	454	4,944
2014	1,267,891,908	32,932,257	164,661,287	148,195,158	1,613,680,611
	3,891	101	505	455	4,952

2015	1,156,618,997	30,042,052	150,210,259	135,189,233	1,472,060,542
	3,550	92	461	415	4,518
2016	1,198,297,309	31,124,605	155,623,027	140,060,724	1,525,105,666
	3,677	96	478	430	4,680
2017	1,313,047,647	13,762,918	58,730,960	138,487,847	1,524,029,372
	4,030	42	180	425	4,677
2018	1,245,032,628	14,278,724	56,360,950	139,196,556	1,454,868,858
	3,821	44	173	427	4,465
2019	1,357,176,610	12,911,356	54,294,890	126,532,663	1,550,915,519
	4,165	40	167	388	4,760
2020	1,598,820,015	14,243,120	66,482,100	142,489,159	1,822,034,394
	4,907	44	204	437	5,592

6.1.2 DFC Considerations

The dominant use of the aquifer by pumping is public water supply, and the sustainability of that supply, especially for users who have no alternative supply physically or economically available and/or who are in vulnerable locations, must be protected to the extent feasible (Texas Water Code §36). The primary concern with sustainability of this karst aquifer groundwater supply is drought, notably extreme drought that stresses the entire aquifer, but especially the western portion of the northern subdivision. Both DFCs support and are, in fact, linchpins of a drought management program to promote long-term sustainability of both springflow and water supplies. Additional firm-yield water supplies must be provided from other sources, while conditional- permitted withdrawals from the aquifer are only available on an interruptible basis.

The All Conditions DFC is expressly designed to postpone as long as possible permitted pumping curtailments that would be triggered by a District-declared drought. Postponement would be effected by delaying, to an acceptable degree, the elevation of a designation of drought from a non-drought designation that is attendant with pumping. The Extreme Drought DFC is designed to serve the mutual management objectives of: 1) preserving water supplies, especially in the more vulnerable western portions of the District and 2) minimizing the amount of take and avoiding jeopardy of the two endangered species that have the natural outlets of the aquifer as sole habitat. The DFC allows an amount of groundwater use that would produce a lower springflow than the historically low springflow during the 1950s drought of record, but still maintain acceptable minimum spring discharge levels.

6.2 Water-Supply Needs

6.2.1 Description of Factors in the Northern Subdivision, GMA 10

The discussion in this section is taken from BSEACD’s Management Plan (BSEACD, 2018). For estimating projected water supply needs (i.e., water demand vs. supply) BSEACD used data extracted from the 2020 State Water Plan and provided by the TWDB. The TWDB provides water-supply needs estimates by decade as well as by county. The decadal estimates for 2020 are used to approximate demand for the year 2022, the final year of BSEACD’s Management Plan (BSEACD, 2018). A summary of the projected water-supply needs is provided in the Table 4 by decade in acre-ft/yr.

Table 4. Projected water-supply needs in BSEACD for the 2022 State Water Plan planning period 2020-2070.

	2020	2030	2040	2050	2060	2070
Travis	357	790	2,328	2,975	3,618	5,036
Hays	266	1,734	4,416	7,969	13,318	20,548
Caldwell	6	13	26	62	100	138
Totals	**629**	**2,537**	**6,770**	**11,006**	**17,036**	**25,722**

* These numbers reflect BSEACD's actual needs based on the apportioning multiplier and not the whole county (Table 8)

The projections in Table 4 shows that for the 2021 State Water Plan planning period (2020-2070), there is a progressively increasing water-supply deficit, increasing from 623 acre-ft in 2020 up to 25 acre-ft in 2070. These water-supply needs in BSEACD arise primarily from and are dominated by the burgeoning growth on the southern fringe of the Austin metropolitan area, and also in the gradual diminution of the surface-water supplies, as reservoir capacity decreases with time. As in prior plans, some of the water-demand deficits in the BSEACD area in the out-years (the later years in the planning period) include numerous contractual shortages. These contractual shortages will be addressed on an *ad-hoc* basis, through the renewal and expansion of contracts with wholesale water suppliers and the contractual reallocation of existing supplies in order to address the projected water demands for these and other area water-user groups. But even so, it is projected that there will be unmet needs in BSEACD, especially under drought-of-record conditions and in the out-years.

6.2.2 DFC Considerations

The population growth of the Austin-San Marcos metropolitan area is creating demand for additional water supplies from all sources, both within and outside of the northern subdivision. The DFCs maximize the amount of water that can be provided during non-drought periods that is consistent with the implementation of a drought management program that protects the supply for existing uses during drought, especially extreme drought. The drought program response to the DFCs indexes the amount of aquifer water available to meet the needs with the severity of drought.

6.3 Water-Management Strategies

6.3.1 Description of Factors in Northern Subdivision, GMA 10

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018), the 2021 Regions K and L Water Planning Group Plans, and the 2022 State Water Plan, which relies on the Water Planning Group Plans.

Water management strategies for the northern subdivision included in the regional and state water plans are diverse, arising from the increasing deficit in supply relative to the burgeoning demand in the northern subdivision. Strategies include increased public/municipal water conservation, drought management, use/transfer of available or re-allocated surface water supplies, purchase of water from wholesale water providers, purchase of Carrizo-Wilcox water, development of the saline zone of the Edwards (Balcones Fault Zone) water, development of theTrinity Aquifer, Edwards/Middle

Trinity ASR, and saline Edwards ASR. Perhaps even more on point here is that increased use of the fresh Edwards (Balcones Fault Zone) Aquifer water is not included as a strategy, as it is widely recognized as fully subscribed. None of the Water User Groups in the northern subdivision include allocation or transfer of their existing supplies.

6.3.2 DFC Considerations

The DFCs under consideration here are specific to the freshwater portion of the Edwards (Balcones Fault Zone) Aquifer in the northern subdivision of GMA 10. The saline portion of that aquifer has a different DFC and is the subject of a separate groundwater management zone, designed to promote utilization of the saline resource via desalination and/or as host for ASR facilities. The All-Conditions DFC, by design, accommodates a certain amount of use for ASR during non-drought periods. Both DFCs, as described above, underpin an aquifer-responsive drought management program that encourages both full-time water conservation and further temporary curtailments in pumping during drought periods that increase with drought severity. These curtailments in pumping alsopromote the use of alternative water supplies consistent with the water management strategies.

6.4 Hydrological Conditions

6.4.1 Description of Factors in Northern Subdivision, GMA 10

6.4.1.1 Total Estimated Recoverable Storage

Texas statute requires that the TERS of relevant aquifers be determined (Texas Water Code § 36.108) by the TWDB. Texas Administrative Code Rule §356.10 (23) (Texas Administrative Code, 2011) defines the TERS as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume.

TERS values may include a mixture of water-quality types, including fresh, brackish, and saline groundwater, because the available data and the existing Groundwater Availability Models do not permit the differentiation between different water- quality types. The TERS values do not take into account the effects of land surface subsidence, degradation of water quality,any changes to surface-water/groundwater interaction that may occur due to pumping, springflow or impacts on endangered species.

The total recoverable storage estimated for the Edwards (Balcones Fault Zone) Aquifer within BSEACD is listed in Table 5 (Jones et al., 2013). The total recoverable storage estimated for the Edwards (Balcones Fault Zone) Aquifer within Hays and Travis counties in GMA 10 is listed in Table 6 (Jones et al., 2013). The total recoverable storage estimated for Hays County includes groundwater in the San Antonio segment as well as the Barton Springs segment of the Edwards Aquifer, so not all of the water shown in Table 6 is in the northern subdivision of GMA 10.

Table 5. Total estimated recoverable storage for the Edwards (Balcones Fault Zone) Aquifer within BSEACD in Groundwater Management Area 10. Estimates are rounded within two significant numbers (Jones et al., 2013).

Total Storage (acre-ft)	25 percent of Total Storage (acre-ft)	75 percent of Total Storage (acre-ft)
130,000	32,500	97,500

Table 6. Total estimated recoverable storage for the Edwards (Balcones Fault Zone) Aquifer within Hays and Travis counties in Groundwater Management Area 10. Estimates are rounded within two significant numbers (Jones et al., 2013).

County	Total Storage (acre-ft)	25 percent of Total Storage (acre-ft)	75 percent of Total Storage (acre-ft)
Hays	200,000	50,000	150,000
Travis	69,000	17,250	51,750

6.4.1.2 Average Annual Recharge

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018). For the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer, the long-term mean surface recharge should approximately equal the mean natural (i.e., with no well withdrawals) spring discharge, which is reported to be about 53 cfs at Barton Springs (Slade et al., 1986; Scanlon et al., 2001). Since the 1950s drought, the mean natural springflow at Barton Springs has been higher, about 62 cfs (Hunt et al., 2012; Johns, 2016). The distribution and volume of this recharge have been modeled multiple times. Scanlon et al. (2001) estimated average recharge at 55 cfs (39,844 acre-ft/yr) in the initial groundwater availability model of the Barton Springs segment for the TWDB. A later report by the TWDB, GAM Run 08-37 (Oliver, 2008), summarized the estimated amount of recharge from precipitation, the amount of spring discharge, and the amount of flow into and out of BSEACD for steady-state conditions in 1989 (Table 7). As illustrated in Table 7, annual recharge from precipitation for the modeling was 42,858 acre-ft.

The majority (as much as 85 percent) of recharge to the aquifer is derived from streams originating on the contributing zone, located up gradient and to the west of the recharge zone. Water flowing onto the recharge zone sinks into numerous caves, sinkholes, and fractures along its six major, ephemeral losing streams. The remaining recharge (15 percent) occurs in the upland areas of the recharge zone (Slade et al., 1986). Current studies indicate that upland recharge may constitute a larger fraction (up to 30 percent) of recharge (Hauwert, 2009; Hauwert, 2011). Slade (2014) more recently calculated the upland recharge at 25 percent of the total. Studies have shown that recharge is highly variable in space and time and is focused within discrete features (Smith et al., 2011). For example, Onion Creek is the largest contributor of recharge (34 percent) with maximum recharge rates up to 160 cfs (Slade et al., 1986; Fieseler, 1998). Antioch Cave is located within Onion Creek and is the largest-capacity recharge feature with an average recharge of 46 cfs and a maximum of 95 cfs during one 100-day study (Fieseler, 1998). Recent work at Antioch Cave has also documented greater than 100 cfs of recharge entering the aquifer through the entrance to Antioch

Cave (Smith et al., 2011). Dye-tracing studies have shown that some of this water flows directly and very rapidly to Barton Springs with an unknown percentage contributing to storage.

Table 7. Summarized information needed for BSEACD's groundwater management plan. All values are reported in acre-ft/yr. All numbers are rounded to the nearest 1 acre-ft. Negative values indicate water is leaving the aquifer system using the parameters or boundaries listed in the table (Oliver, 2008).

Barton Springs/Edwards Aquifer Conservation District Management Plan Requirement	Aquifer or confiningunit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards and associated limestones	42,858[a]
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards and associated limestones	-39,723
Estimated annual volume of flow into the district within each aquifer in the district	Edwards and associated limestones	3,191[b]
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards and associated limestones	-2,651[b]
Estimated net annual volume of flow between each aquifer in the district	Edwards into Trinity	0[c]

[a] Recharge value includes concentrated infiltration of water from stream channels. Scanlon and et al. (2001) estimated that approximately 15 percent of recharge in the model was due to diffuse inter-stream recharge, or direct infiltration of precipitation, which equates to approximately 6,429 acre-ft/yr.
[b] The orientation of the model cells and the political jurisdictional boundaries of the district do not align perfectly, therefore even though the district is larger than the model boundaries, some flow into and out of the district is reported due to the method of data extraction from the model.[c] The Groundwater Availability Model (Oliver, 2008) does not consider flow into or out of the Edwards (Balcones Fault Zone) Aquifer from other formations.

Groundwater divides delineate the boundaries of aquifer systems and influence not only the local aquifer hydrodynamics, but also the groundwater budget (recharge and discharge). The groundwater divide separating the San Antonio and Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer has historically been drawn along topographic or surface water divides between the Blanco River and Onion Creek in the recharge zone, and along potentiometric highs in the confined zone between the cities of Kyle and Buda in Hays County. Recent studies reveal that during wet conditions the groundwater divide is located generally along Onion Creek in the recharge zone, extending easterly along a potentiometric ridge between the cities of Kyle and Buda toward the saline-zone boundary (Hunt et al. 2006). During dry conditions, Hunt et al. (2006) posit that the hydrologic divide migrates south and is located along the Blanco River in the recharge zone, extending southeasterly to San Marcos Springs (Johnson et al., 2011). Thus, the groundwater divide is a hydrodynamic feature dependent upon the hydrologic conditions (wet versus dry) and the resulting hydraulic heads between Onion Creek and the Blanco River. Under extreme drought conditions, some groundwater flow from the west may bypass San Marcos Springs and continue toward Barton Springs (Land et al., 2011) and some surface water from the

Blanco River may recharge the Barton Springs segment rather than the San Antonio segment (Smith et al., 2012).

6.4.1.3 Inflows

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018). The amount of cross-formational inflow (subsurface recharge) occurring through adjacent aquifers into the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer is unknown, although it is thought to be relatively small on the basis of water-budget analysis for surface recharge and discharge (Slade et al., 1985). Recent studies by BSEACD and others have shown the potential for cross-formational flow both to and from the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer. Sources of cross-formational flow are discussed below and include the saline-water zone, San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer, the Trinity Aquifer, and urbanrecharge.

Leakage from the saline-water zone into the freshwater zone is probably minimal, although leakage appears to influence water chemistry at Barton Springs during low-flow conditions (Senger and Kreitler, 1984; Slade et al., 1986). Recent studies indicate that the fresh-saline zone interface may be relatively stable over time (Lambert et al., 2010; Brakefield, 2015). On the basis of a geochemical evaluation, Hauwert et al. (2004) state that the saline-water zone contribution could be as high as 3 percent for Old Mill Spring and 0.5 percent for Main and Eliza Springs under low-flow conditions of 17cfs (combined) Barton Springs flow. These estimates were independently recalculated and corroborated by Johns (2006) and are similar to the results of Garner and Mahler (2007). Under normal flow conditions contribution from the saline-water zone would be smaller. Massei et al. (2007) noted that specific conductance of Barton Springs increased 20 percent under the 2000 drought condition, probably from saline-water zone contribution.

Subsurface flow into the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer from the adjacent San Antonio segment located to the southwest is limited when compared with surface recharge (Slade et al., 1985). Hauwert et al. (2004) indicated that flow across the southern boundary of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer is probably insignificant under normal conditions. Recent studies have documented that the southern boundary of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer is hydrodynamic in nature and fluctuates between Onion Creek and the Blanco River.

Accordingly, groundwater from the recharge zone of the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer is flowing into the Barton Springs segment during drought conditions (Smith et al., 2012). Results of recent dye-trace studies indicate that under certain high-flow conditions water recharging along Onion Creek flows from the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer to San Marcos Springs (Hunt et al., 2006). Under moderate drought conditions, water recharged along the Blanco River can flow to both San Marcos and Barton springs (Smith et al., 2012). Under extreme drought conditions, it has been estimated that up to 5 cfs of groundwater flow bypasses (underflows) San Marcos Springs and flows toward Barton Springs (Land et al., 2011).

Changes in land use influence the inflows of aquifers systems. Studies have shown that urbanization may increase recharge to the Edwards (Balcones Fault Zone) Aquifer (Sharp, 2010; Sharp et al., 2009). Sources of the increase in recharge include leaking infrastructure such as pressurized potable water lines, wastewater from both collector lines and septic tank drainfields, and stormwater in infiltration basins in the recharge zone. Recharge in urban environments is increased from the return flows of irrigation practices (e.g. lawn watering) and when impervious cover decreases evapotranspiration (Sharp, 2010; Sharp et al., 2009).

6.4.1.4 Discharge

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018). The largest natural discharge point of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer is Barton Springs, the fourth largest spring in Texas. Barton Springs consist of four major outlets: Main, Eliza, Old Mill, and Upper. Main Spring is the largest and discharges directly into Barton Springs Pool. Springflow at Barton Springs is determined and reported by the U.S. Geological Survey. Discharge reported for Barton Springs is based on a rating-curve correlation between water levels in the Barton Well (State Well Number 5842903) and physical flow measurements from Main, Eliza, and Old Mill. Flow from Upper Barton Springs, which is located about 400 feet upstream of the pool, is not included in the reported discharge, and bypasses the pool. Upper Barton Springs is characterized as an "overflow" spring and only flows when the total discharge at Barton Springs exceeds about 40 cfs (Hauwert et al., 2004).

Barton Springs has a long record of continuous discharge data beginning in 1917. Monthly mean data are available from 1917 to 1978 (Slade et al., 1986), and daily mean discharge data are available thereafter. The long-term average springflow at Barton Springs is 53 cfs based on data from 1917 to 1995 and is a widely reported value (Slade et al., 1986; Scanlon et al., 2001; Hauwert et al., 2004). More recent studies indicate that average springflows after the 1950s drought are higher, about 62 cfs (Hunt et al., 2012; Johns, 2016). The maximum and minimum measured discharges are 166 and 9.6 cfs, respectively. The lowest measured spring discharge value occurred on March 26, 1956 during the 1950s drought (Slade et al., 1986). Low-flow periods are defined as discharge below 35 cfs, moderate-flow conditions occur between 35 and 70 cfs, and high-flow conditions correspond to flows greater than 70 cfs (Hauwert et al., 2004). Mahler et al. (2006) define low flow as below 40 cfs. A peak in the daily average flow occurs in June following the average peak rainfall in May.

Barton Springs discharge is typical of a spring in a karst system that responds dynamically to recharge events and integrates conduit, fracture, and matrix flow. Springflow recessions and discharge rates are in large part determined by pre-existing conditions, the magnitude of recharge, and location of recharge. Massei et al. (2007) identify several source-water types contributing to the specific conductivity measured in Barton Springs. Sources include matrix, surface water, saline water, and other unidentified sources. Their relative contributions are dependent upon aquifer response to climatic and hydrologic conditions. Generally speaking; however, base springflow during periods of drought is sustained by the discharge of the matrix-flow system into the conduit system (White, 1988; Mahler et al., 2006).

The Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer contains other smaller springs. Cold Springs discharges directly into the Colorado River and is partially submerged by Lady Bird Lake. There are very few discharge data for Cold Springs, but its discharge is estimated to be about 5 percent of Barton Springs discharge (Scanlon et al., 2001). Similarly, Slade (2014) indicates the long-term average discharge of Cold Springs is about 5.5 cfs. A small spring named Rollingwood Spring, near Cold Springs, discharges into the Colorado River at a rate of about 0.02 to 0.06 cfs. Backdoor Spring is a small, perched spring located on Barton Creek and has discharge of about 0.02 cfs. Bee Springs is a small, perched spring and seep horizon discharging along Bee Creek and into Lake Austin and discharges about 0.2 to 0.6 cfs (Hauwert et al., 2004).

GAM Run 08-37 (Oliver, 2008) states that discharge from Barton and Cold springs was 39,723 acre-ft/yr (54.9 cfs) under steady-state conditions in 1989. The amount of water withdrawn from wells was 3,135 acre-ft (4.3 cfs) at that time (Table 4).

6.4.1.5 Other Environmental Impacts Including Springflow and Groundwater/Surface-Water Interaction

The discussion in this section is taken from BSEACD's Management Plan (BSEACD, 2018). The surface-water supply in BSEACD is provided primarily by run-of-river diversions and especially by reservoirs in the Colorado River basin. The southeastern-most part of BSEACD in Hays County and is supplied by the Guadalupe-Blanco River system, especially water from main-stem reservoirs like Canyon Lake. Most of this Guadalupe-Blanco water is conveyed to some users in BSEACD by the Hays County Pipeline.

Projected water-supply data have been extracted from the 2021 State Water Plan database and provided by the TWDB at the county level. The projections are estimated using an apportioning multiplier derived from the ratio of the land area of BSEACD in the county relative to the entire county area. The apportioning multiplier was used for all water-user groups except for public-water supplies (i.e. municipalities, water supply corporations, and utility districts). The derivation of these apportioning multipliers is shown in Table 8.

Table 8. Areal distribution of BSEACD by County. Most of BSEACD is in Travis and Hays Counties, in sub-equal amounts; BSEACD comprises only a small part of Caldwell County. (BSEACD Management Plan) (acre-ft/yr).

County	BSEACD Total Acres in County	BSEACD Acres in District	Plum Creek Conservation District Acres in District	Percent in BSEACD prior to 2015	Percent in Plum Creek	Total percent or apportioning multiplier
Travis	656,348	74,311	NA	11.5%	NA	11.5%
Hays	433,248	184,513	39,425	42.5%	9.1%	51.6%
Caldwell	350,498	16,777	180,611	4.5%	51.53%	56.03%

The total annual projected surface-water supply in the counties of BSEACD is estimated to be 293,027 acre-ft in 2020 (2020 is the closest decadal estimate to 2022, the final year of BSEACD's Management Plan). These supplies refer to the firm-yield supplies from surface-water sources during a recurrence of the drought of record. For comparison purposes, the projected surface-water supplies from the three primary counties comprising BSEACD (Bastrop was excluded because its area has been de-annexed sincethe previous management plan was approved) are provided in Table 9 by decade in acre-ft.

Table 9. Projected annual surface-water supplies provided by county (Region K and L Water Plans) (acre-ft/yr)

	2020	2030	2040	2050	2060	2070
Travis	25,140	25,140	25,140	25,140	25,140	25,140
Hays	111	111	111	111	111	111
Caldwell	46	46	46	46	46	46
Total	**25,297**	**25,297**	**25,297**	**25,297**	**25,297**	**25,297**

* These numbers reflect BSEACD's actual needs based on the apportioning multiplier and not the whole county (Table 8)

6.4.2 DFC Considerations

The DFCs are proposed on the basis that the aquifer is hydrologically a classic karst aquifer, with temporally variable inflows from various recharge sources and a major natural discharge point at Barton Springs that is also temporally variable with aquifer conditions. This hydrologic condition denotes that it is highly vulnerable to drought, and water supplies are substantially adversely affected by drought. Additionally, the geologic strata that form the aquifer dip regionally to the southeast, such that both the saturated thickness in the unconfined zone and the artesian pressure head in the confined zone are larger to the southeast. However, while faulted, the aquifer is well-integrated hydrologically and has a common potentiometric surface throughout the subdivision.

The springflow at Barton Springs is directly and essentially solely related to the elevation of the potentiometric surface, regardless of the different thickness and depth of groundwater that exists in various parts of the subdivision or other hydrologic conditions, except as they affect the potentiometric surface. So the proposed DFCs relate to the elevations of the potentiometric surface corresponding to two different conditions, regardless of the volumes of water in storage at any one location. The elevation of water near the drought/non-drought boundary combines with the geometric configuration of the aquifer host at that elevation and the rate of aquifer discharge, including the amount of pumping, to control the rate of acceleration into drought from non-drought conditions.

Preservation of a minimal springflow at Barton Springs and a related dissolved oxygen concentration that will sustain the endangered species at the spring outlets is mandated by federal law. The Extreme Drought DFC is expressly designed to provide that level of environmental and ecological protection.

7. Subsidence Impacts

Subsidence has historically not been an issue with the Northern Fresh Edwards Aquifer in GMA 10. The aquifer matrix in the northern subdivision is well-indurated and the amount of pumping does not create compaction of the host rock and/or subsidence of the land surface. Hence, the proposed DFCs are not affected by and do not affect land-surface subsidence or compaction of the aquifer.

Additionally, LRE Water LLC hydrologists have built a Subsidence Prediction Tool (SPT) that takes individual well characteristics and calculates a potential subsidence risk in a localized area. GMA 10 recognizes that the general reports from the SPT indicate that subsidence is not a concern for GMA 10 at this time.

8. Socioeconomic Impacts Reasonably Expected to Occur

8.1 Description of Factors in Northern Subdivision, GMA 10

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process. The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs [§357.7 (4)]. Staff of the TWDB's Water Resources Planning Division designed and conducted a report in support of the South Central Texas Regional Water Planning Group (Region L) and also the Lower Colorado Regional Water Planning Group (Region K). The report "Socioeconomic Impacts of Projected Water Shortages for the South Central Texas Regional Water Planning Area (Region L)" was prepared by the TWDB in support of the 2021 South Central Texas Regional Water Plan and is illustrative of these types of analyses.

The report on socioeconomic impacts summarizes the results of the TWDB analysis and discusses the methodology used to generate the results for Region L. The socioeconomic impact reports for Water Planning Groups K and L are included in Appendix A. These reports are supportive of a cost-benefit assessment of the water management strategies and the socioeconomic impact of not promulgating those strategies.

The maintenance of the natural discharge of the Aquifer at iconic Barton Springs supports recreation and tourism that is a recognized socioeconomic engine for central Texas.

8.2 DFC Considerations

Because none of the water management strategies involve changes in the current use of the freshwater portion of the Edwards (Balcones Fault Zone) Aquifer in the northern subdivision of GMA 10, as described in Section 6.3, the proposed DFCs do not have a differential socioeconomic impact. They are supportive of the status quo in this regard, which is considered positive.

9. Private Property Impacts

9.1 Description of Factors in Northern Subdivision, GMA 10

The interests and rights in private property, including ownership and the rights of GMA 10 landowners and their lessees and assigns in groundwater, are recognized under Texas Water Code Section 36.002. The legislature recognized that a landowner owns the groundwater below the surface of the landowner's land as real property. Joint planning must take into account the impacts on those rights in the process of establishing DFCs, including the property rights of both existing and future groundwater users. Nothing should be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by this section. At the same time, the law holds that no landowner is guaranteed a certain amount of such groundwater below the surface of his/her land.

Texas Water Code Section 36.002 does not: (1) prohibit a district from limiting or prohibiting the drilling of a well by a landowner for failure or inability to comply with minimum well spacing or tract size requirements adopted by the district; (2) affect the ability of a district to regulate groundwater production as authorized under Section 36.113, 36.116, or 36.122 or otherwise under this chapter or a special law governing a district; or (3) require that a rule adopted by a district allocate to each landowner a proportionate share of available groundwater for production from the aquifer based on the number of acres owned by the landowner.

9.2 DFC Considerations

The DFCs are designed to protect the sustained use of the aquifer as a water supply for all users in aggregate and as ecological habitat for protected species. Neither DFC prevents use of the groundwater by landowners either now or in the future, although ultimately total use of the groundwater in the aquifer is restricted by the aquifer condition, and that may affect the amount of water that any one landowner could use, either at particular times or all of the time.

10. Feasibility of Achieving the DFCs

The feasibility of achieving a DFC directly relates to the ability of BSEACD to manage the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer to achieve the DFCs, including promulgating and enforcing rules and other board actions that support the DFCs. The feasibility of achieving this goal is limited by (1) the finite nature of the resource and how it responds to drought; (2) the pressures placed on this resource by the high level of economic and population growth within the area served by this resource; and (3) how the endangered species habitat at Barton Springs is protected in response to federal statute. Texas State law provides Groundwater Conservation Districts with the responsibility and authority to conserve, preserve, and protect these resources and to ensure for the recharge and prevention of waste of groundwater and control of subsidence in the management area. State law also provides that GMAs assist in that endeavor by joint regional planning that balances aquifer protection and highest practicable production of groundwater. The feasibility of achieving these goals could be altered if state law is revised or interpreted differently than is currently the case.

The caveats above notwithstanding, the current regulatory program of BSEACD is designed to achieve the proposed DFCs, andthere is no reason to consider that it is not feasible to achieve the DFCs.

11. Discussion of Other DFCs Considered

No other DFC of the fresh Edwards (Balcones Fault Zone) Aquifer in the GMA's northern subdivision was considered.

12. Discussion of Other Recommendations

12.1 Advisory Committees

An Advisory Committee for GMA10 has not been established.

12.2 Public Comments

GMA 10 approved its proposed DFCs on April 20, 2021. In accordance with requirements in Chapter 36.108(d-2), each GCD then had 90 days to hold a public meeting at which stakeholder input was documented. This input was submitted by the GCD to the GMA within this 90-day period. The dates on which each GCD held its public meeting is summarized in Table 10. Public comments for GMA 10 are included in Appendix B.

Table 10. Dates on which each GCD held a public meeting allowing for stakeholder input on the DFCs.

GCD	Date
Barton Springs/Edwards Aquifer Conservation District	June 10, 2021
Comal Trinity GCD	May 17, 2021
Kinney County GCD	June 10, 2021
Medina County GCD	June 16, 2021
Plum Creek Conservation District	June 30, 2021
Uvalde County UWCD	May 19, 2021

Under Texas Water Code, Ch. 36.108(d-3)(5), GMA 10 is required to "discuss reasons why recommendations made by advisory committees and relevant public comments were or were not incorporated into the desired future conditions" in each DFC Explanatory Report.

13. Any Other Information Relevant to the Specific DFCs

As the down-dip Trinity Aquifer is increasingly used as a water supply in GMA 10 in lieu of the more restricted Edwards (Balcones Fault Zone) Aquifer, additional information on how its groundwater relates to the Edwards (Balcones Fault Zone) Aquifer is being elucidated. This new information may ultimately change what DFC for the northern subdivision of the fresh Edwards is and isn't feasible, and therefore what MAG is consistent with that DFC.

In the northern subdivision of GMA 10, there is no evidence that the Edwards and the Middle Trinity (and by inference, the Lower Trinity) aquifers are significantly hydrologically connected (Wong et al., 2014). Thus, pumping from one is not likely to appreciably affect the water available in the other. On the other hand, there is a demonstrable hydrologic connection between the Upper Trinity Aquifer and the Edwards Aquifer where the Upper Trinity Aquifer underlies the Edwards Aquifer; in fact, from a hydrostratigraphic standpoint, the top 100 feet or so of the Upper Glen Rose (i.e., traditionally, the uppermost Upper Trinity Aquifer) may be more correctly considered part of the Edwards Aquifer in some locations (Wong et al., 2014). Pumping in the Edwards Aquifer near its western boundary can induce flow from the Upper Trinity Aquifer, and that induced water flow may be of considerably poorer quality that could affect the existing use of the Edwards Aquifer wells.

In addition, as noted earlier, the Blanco River, which has base flow largely determined by discharges from the Middle and Upper Trinity Aquifers upgradient of GMA 10, now appears to be a substantial source of springflows at Barton Springs during extreme drought conditions. Increased pumping of the Trinity Aquifer, especially the Middle Trinity Aquifer, in the watersheds upstream of the recharge zone of the Edwards Aquifer may reduce the amount of recharge available to the Edwards Aquifer and therefore the springflows at Barton Springs during extreme droughts (Hunt et al., 2012). While this pumping would occur in GMA 9, its adverse impacts would be felt in the northern subdivision of GMA 10.

14. 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

The TWDB has not developed guidance on how to approach this factor. It is up to the wishes of the GCDs on how they wish to approach it, whether in a qualitative, quantitative, or combination manner. But, the GCDs need to include stakeholder input so that this factor can be satisfactorily addressed. GCD management plans will be used to complete this requirement.

That said, it is relevant here that BSEACD has established a conditional permitting program that promotes responsible use of the resources of this particular aquifer while the necessary restrictions during extreme drought conditions can continue to be effective. The Extreme Drought DFC, among other things, will become a specified part of the District's planned response to comply with federal law concerning endangered species, the now issued federal Incidental Take Permit, which will allow a curtailed amount of pumping to take place even during extreme drought. And in addition, the primary objective of the All Conditions DFC is to delay the onset of conditions triggering district-declared drought and minimize the length of time that all BSEACD permittees are required to curtail all or part of their authorized groundwater use during drought.

This DFC is designed to balance 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. This balance is demonstrated in (a) how GMA 10 has assessed and incorporated each of the nine factors used to establish the DFC, as described in Chapter 6 of this Explanatory Report, and (b) how GMA 10 responded to certain public comments and concerns expressed in timely public meetings that followed proposing the DFC, as described more specifically in Appendix B of this Explanatory Report. Further, this approved DFC will enable current and future Management Plans and regulations of those GMA 10 GCDs charged with achieving this DFC to balance specific local risks arising from protecting the aquifer while maximizing groundwater production.

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