BANKING ON CREDITS

Taking Steps to Ensure Mitigation Banks Meet the Credit Demand Generated by the Long-Range Transportation Plan

June 2016

NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS

Executive Summary

Federal laws require agencies that construct transportation projects to mitigate and, in some cases, compensate for the impacts those projects have on wetlands and streams. Under Section 404(b)(1) of the Clean Water Act, the preferred form of compensatory mitigation is the purchase of mitigation bank credits. If mitigation bank credits are not available, agencies building transportation projects must create their own mitigation sites which is financially risky and can delay construction. A lack of mitigation credits has created project delays for the North Carolina Department of Transportation and led to high mitigation costs for the California Department of Transportation. Efforts to ensure sufficient credits are available have saved more than $100 million in Florida.

The North Central Texas Council of Governments (NCTCOG) sought to determine whether sufficient credits existed to compensate for roadway projects planned for the Dallas-Fort Worth region through the years 2027 and 2040. The agency conducts long-range transportation planning as the 12-county region's Metropolitan Planning Organization and allocates local, state, and federal funding to regionally significant transportation projects. NCTCOG received funding from the Federal Highway Administration's Strategic Highway Research Program Implementation Assistance Program to assess the status of mitigation banking credits in the region.

Through its Wetland and Stream Mitigation Assessment, NCTCOG found that the region's rapidly growing northern counties face a shortage of available stream credits and the southwestern counties lack available wetland credits. Real estate and development projects create the second largest demand for stream credits in the region, following transportation projects. Planned roadway projects and expected population growth make a shortage of stream mitigation credits a critical issue. NCTCOG must take steps to ensure that sufficient mitigation credits are available for future transportation projects.

Research conducted by NCTCOG staff found that mitigation banking is a risky investment. Entrepreneurs must spend a significant amount of capital long before receiving returns. Mitigation bankers must provide financial assurances to ensure banks are constructed and maintained. They must place the banks' land in a conservation easement and typically must secure water rights from the state.

For these reasons, the Mitigation Assessment resulted in the following recommendations:

- NCTCOG should attempt to identify transportation projects that will be completed in a timeframe that would be most relevant to the timeframe within which mitigation bankers construct banks.
- NCTCOG should explore the benefits of establishing early payment opportunities that give the mitigation banking market the best opportunity to respond to the demand created by transportation projects.
- Transportation planning partners should sponsor a forum for mitigation bankers and environmental consultants interested in developing mitigation credits in the region. This forum must provide a level playing field where bankers and consultants can communicate to NCTCOG the information they need to consider constructing a mitigation bank.
- The Regional Transportation Council should adopt a policy requiring mitigation credits to be purchased in primary service areas, when possible, to provide the most cost-effective mitigation.

The benefits of proactively addressing mitigation credit shortages are broad. Transportation partners can prevent construction delays and reduce mitigation costs. Bankers can benefit from reduced risk if they have a guaranteed market for credits. And strategically sited banks can provide ecological benefits to watersheds impacted by transportation projects.

Mitigation Practices in Transportation Planning

Transportation projects can negatively impact aquatic resources such as wetlands and streams. These freshwater ecosystems are some of the most threatened ecosystems in the world (Moilanen, Leathwick, & Elith, 2008). In Texas, 52 percent of wetlands have been lost or converted to other uses since 1780 (Dodds & Whiles, 2010). A survey of the nation's streams and rivers conducted by the U.S. Environmental Protection Agency (EPA) in 2008 to 2009 found that 46 percent exhibited poor biological condition and more than 40 percent experienced high levels of the pollutants nitrogen and phosphorus (EPA, 2016).

Roads are both a conduit for threats to freshwater ecosystems and a threat themselves. Sediment that enters waterbodies during road construction can kill organisms that live in the water. Road construction can alter stream channels, affecting habitat and the flow of water. New roads can change how water runs off land and can transport pollutants and contribute to new pollutants (Trombulak & Frissell, 2000).

Several frameworks exist to prevent and rectify these impacts (Figure 1). Potential impacts are identified during the National Environmental Policy Act (NEPA) process which is required for federally funded projects, including transportation projects. The NEPA process is intended to help public officials make decisions based on environmental consequences and take actions that protect, restore, and enhance the environment. The NEPA process usually leads officials to consider mitigation (Federal Highway Administration, n.d.).

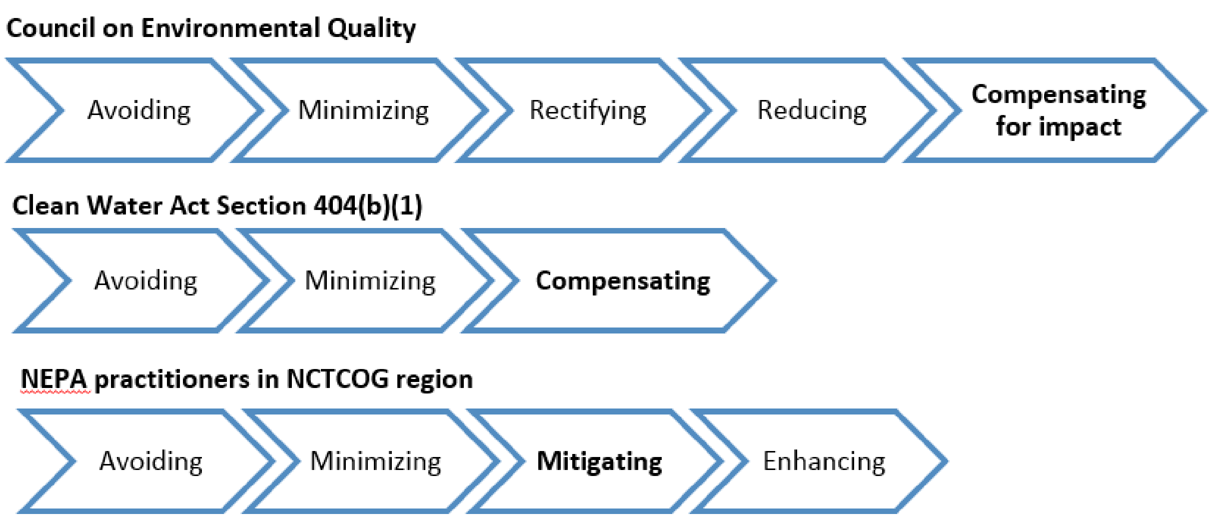

Figure 1: Mitigation Assessment's relationship to mitigation sequences

Mitigation in response to impacts also is addressed by the Council on Environmental Quality which defines five steps in its mitigation sequence:

1. Avoiding
2. Minimizing
3. Rectifying

4. Reducing
5. Compensating for impacts (Federal Highway Administration, n.d.).

The U.S. Army Corp of Engineers (USACE) further supports these measures on impacts to waters of the U.S. using the mitigation sequence outlined in Section 404(b)(1) of the Clean Water Act. Proposed impacts must be avoided to the maximum extent practicable. Remaining unavoidable impacts must be minimized and finally compensated to the extent appropriate and practicable. Methods of providing compensatory mitigation for aquatic resources include restoration, establishment, enhancement, and preservation (USACE & USEPA, 2008).

NEPA practitioners in the NCTCOG region practice a similar sequence when approaching mitigation for roadway projects: avoid, minimize, mitigate, and enhance. This sequence ensures the least amount of impacts and disturbances occur to environmental resources including wetlands, streams, and other waters of the U.S.

Compensatory Mitigation Under Section 404(b)(1) of the Clean Water Act

Linear transportation projects, such as roadways, must comply with the requirements of Sections 9 and 10 of the Rivers and Harbors Act and Sections 401, 404, and 408 of the Clean Water Act. This paper addresses compensatory mitigation under Section 404(b)(1) of the Clean Water Act.

Permits under Section 404 regulate "the discharge of dredged or fill material into 'waters of the United States', including wetlands" in an effort to ensure the "biological, chemical, and physical integrity of the nation's waters" (Hough & Robertson, p. 2-3). Legislation, federal rules, and guidance since the 1970s[1] culminated in the USACE and EPA Final Rule for Compensatory Mitigation for Losses of Aquatic Resources (USACE & EPA, 2008). While retaining earlier guidance that required permit seekers to first avoid and minimize impacts before providing compensatory mitigation, the 2008 Final Rule established a hierarchy for compensating for unavoidable impacts with mitigation banks favored over in-lieu fee mitigation which, in turn, is favored over permittee-responsible mitigation. This preference for purchasing credits from mitigation banks was not new for transportation projects; in 1998, the Transportation Equity Act for the 21st Century established a preference for the use of mitigation banks to compensate for impacts to wetlands created by Surface Transportation Program and National Highway System projects (EPA, 2015).

The 2008 Final Rule also established a preference for in-kind mitigation which calls for impacts to an aquatic resource to be compensated for via an aquatic resource that provides similar function and structure – wetlands should be used to mitigate for wetlands and streams should be used to mitigate for streams (USACE & EPA, 2008).

The Fort Worth District of the USACE addressed this preference for in-kind mitigation in 2013 when it adopted its Stream Mitigation Method which required unavoidable impacts to streams to be mitigated with efforts to replace stream and in-channel stream functions. Before the Stream Mitigation Method was adopted, the district allowed compensatory mitigation for stream impacts via improvements to the upland buffers of streams or to wetlands (USACE Fort Worth District, 2013). The Stream Mitigation Method provided a hierarchy of alternatives for perennial, intermittent, and ephemeral streams. The

[1] For a detailed history of legislation, federal rules, and guidance pertaining to mitigation for aquatic resources, see Hough & Robertson, 2009.

preferred alternatives require permittees to mitigate for at least 50 percent of impacts by purchasing in-channel stream credits; if in-channel credits are not available, subsequent alternatives allow permittees to purchase riparian buffer credits, purchase stream credits[2], or conduct permittee-responsible mitigation.

Projects identified as having the greatest impact and requiring the greatest number of credits may require a higher level of planning to ensure that projects are not delayed. The costs invested in compensatory mitigation for infrastructure projects are significant and provide "one of the single largest sources of conservation funding in the U.S." (Crist et al., 2015).

Transportation projects being implemented in areas without mitigation credits can face delays and increased costs. The California Department of Transportation reported that such costs reached $59 million per year (Thorne, Bjorkman, & Huber, 2015). The North Carolina Department of Transportation experienced construction delays in the 1990s because of a lack of mitigation credits (North Carolina Department of Environmental Quality, n.d). When credits are not available, compensatory mitigation may take place via permittee-responsible mitigation which usually occurs on-site. This form of mitigation can delay projects, and it often fails to compensate for impacts (Morgan & Hough, 2015). Nationally, the mean time to process individual and general permits from 2010 to 2014 was 57 days faster when projects were mitigated through banks rather than through permittee-responsible on-site mitigation, or 123 days faster when projects were mitigated through banks rather than permittee-responsible off-site mitigation (USACE Institute for Water Resources, 2015).

To address whether the Dallas-Fort Worth area may lack mitigation credits and face delays in future transportation construction, the Transportation Department of NCTCOG conducted a Wetland and Stream Mitigation Assessment. The Transportation Department conducts long-range transportation planning in its role as the 12-county Dallas-Fort Worth region's Metropolitan Planning Organization and allocates local, state, and federal funding to regionally significant transportation projects. Transportation partners in the region, such as the Texas Department of Transportation (TxDOT) and the North Texas Tollway Authority, design and construct the transportation projects identified in the long-range transportation plan. Efforts to streamline the transportation project delivery process can save NCTCOG and its transportation partners time and money.

The Mitigation Assessment was funded by the Federal Highway Administration's Strategic Highway Research Program Implementation Assistance Program.

The region's current long-range plan, Mobility 2040, recommends road, transit, bicycle, and pedestrian projects to be completed through the year 2040 (NCTCOG, 2016). The Mitigation Assessment evaluates the need for mitigation credits generated by roadway projects in Mobility 2040 (Figures 2 and 3).

Legislation requires long-range transportation plans to discuss potential mitigation activities in consultation with regulatory, wildlife, and land management agencies. Section 6001 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users also calls for long-range transportation plans to identify potential mitigation locations most likely to ameliorate the environmental functions affected by projects in the long-range plan (U.S. Congress, 2005).

[2] Unavoidable impacts to ephemeral streams may be mitigated with ephemeral or intermittent credits, per the Stream Mitigation Method.

Regulations also encourage transportation planners to consider the effects of the long-range plan on the natural environment. These optional efforts encourage transportation planners to coordinate efforts with those of the National Environmental Policy Act in order to streamline the implementation of transportation projects (Federal Highway Administration, 2014) and develop more effective mitigation strategies from an environmental stewardship perspective (Federal Highway Administration, 2014).

This white paper identifies shortages in mitigation credits in the Dallas-Fort Worth area and the legal and financial requirements of mitigation banking. The paper suggests possible solutions to the shortages of mitigation credits in the region. Appendices of the paper describe in more detail the Mitigation Assessment's methods and results.

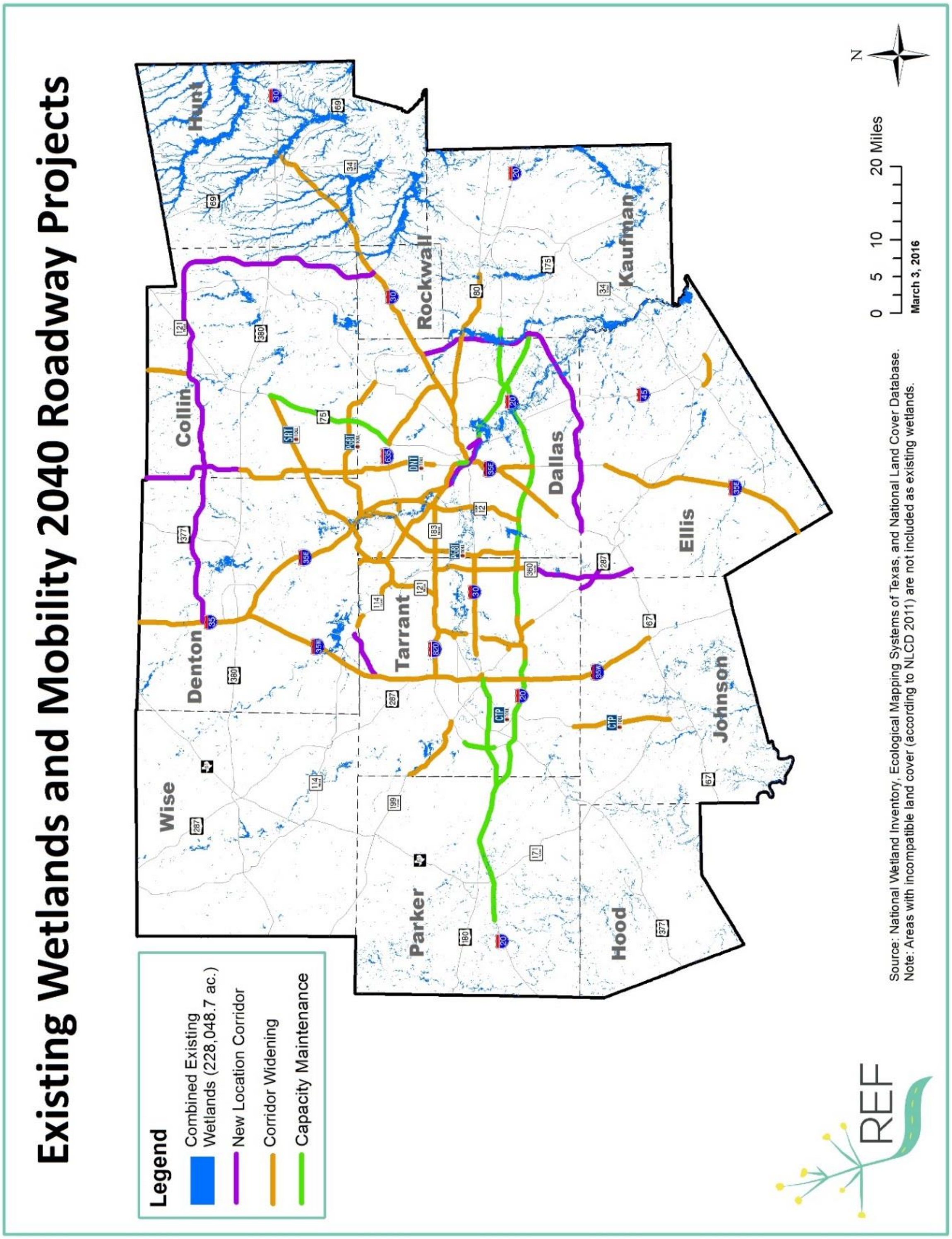

Figure 2: Existing wetland and Mobility 2040 roadway projects

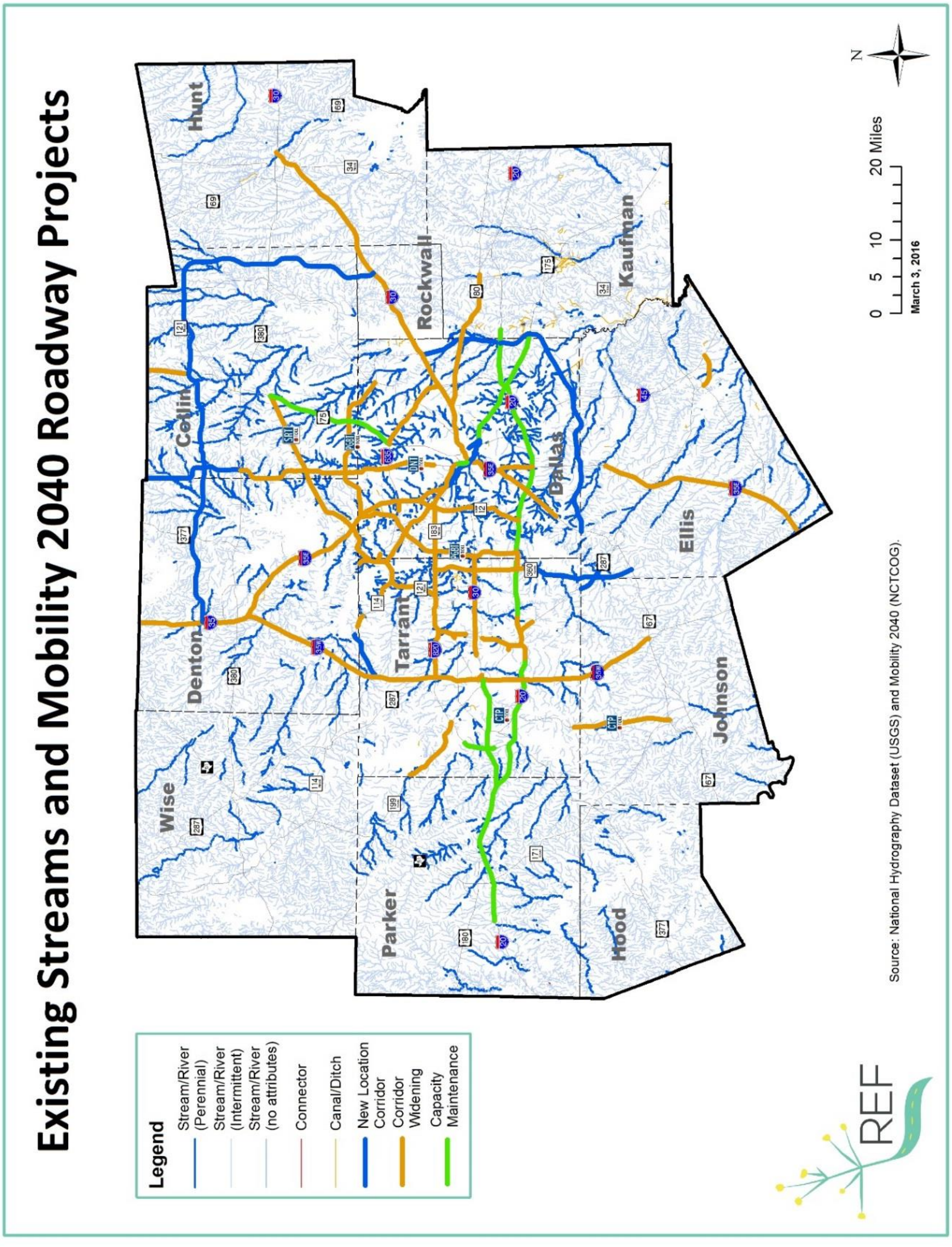

Figure 3: Existing perennial and ephemeral streams and Mobility 2040 roadway projects

Mitigation Banking Research

NCTCOG staff researched the availability of mitigation credits in the Dallas-Fort Worth area and the real estate, legal, and financial requirements of mitigation banking. The Mitigation Assessment also developed a method to identify and prioritize potential sites for new mitigation banks. These efforts were conducted to determine whether the region had a shortage of credits that must be addressed and if so, to determine the best way to address the shortage.

Analysis of Credit Supply

Twenty-one mitigation banks serve the Dallas-Fort Worth area, and nine of them sell stream credits exclusively or in addition to wetland credits. NCTCOG's Mitigation Assessment found that a shortage of some stream credits has occurred since the Fort Worth District implemented its Stream Mitigation Method. Data available online from the Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS) allowed NCTCOG staff to analyze the supply and demand of mitigation bank credits (USACE, n.d.). Stream credits increased after the Stream Mitigation Method was implemented; the number of stream credits available in the Dallas-Fort Worth area increased from about 5,700 combined intermittent and perennial stream credits in 2009 to about 179,800 combined ephemeral, intermittent, and perennial stream credits in 2015 (Figure 4). The majority of stream impacts the Fort Worth District permits affect ephemeral streams (J. Walker, personal communication, March 10, 2016).

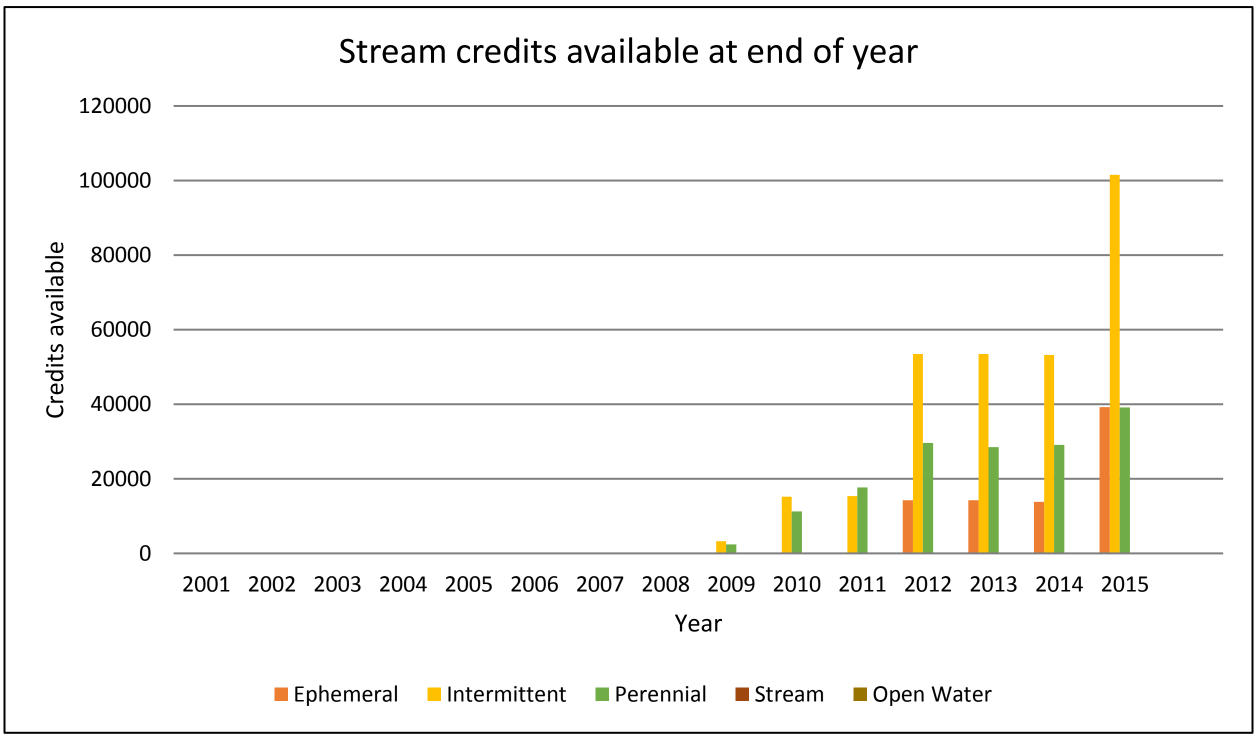

Figure 4: Stream credits available in the Dallas-Fort Worth region at end of year

Despite the increase in stream mitigation credits, the following shortages of stream credits exist:

- Six whole or partial eight-digit hydrologic unit code (HUC-8) watersheds[3] in the southwestern, northwestern, and northeastern portions of the region have neither ephemeral nor intermittent stream credits available.
- Southwestern Hood County has zero stream credits available.
- Northeastern Hunt County has one stream credit available which may only be used for TxDOT projects.
- Five HUC-8 watersheds in the southwestern, northwestern, and northeastern portions of the region have no perennial stream credits available.

Maps of available stream credits can be found in Appendix A – Results.

Wetland credits are available to the majority of the Dallas-Fort Worth area, with the exception of Hood County and western Parker County, which have zero wetland credits available. However, wetland data sources[4] identify fewer acres of wetlands in the western half of the region, so it is likely that fewer impacts will occur in this area. Maps of available wetland credits can be found in Appendix A – Results.

Mitigation bankers may pre-sell credits to compensate for expected impacts that are not yet permitted. These pre-sales are not reflected in RIBITS and may reduce the number of available credits. However, NCTCOG was able to contact seven mitigation bankers that serve the Dallas-Fort Worth region and found none currently have pre-sold credits.

RIBITS provides data on potential but unreleased credits, or those credits that could be available in the future, should mitigation banks build out to their full potential. These credits could become available within the 20-plus year timeframe of Mobility 2040. The majority of the region would have wetland credits available should existing banks build out their potential credits. However, the following areas currently have no or few potential but unreleased credits:

- Two southwestern HUC-8s have zero potential wetland credits
- Four western and eastern HUC-8s have no potential perennial stream credits.
- Six western and eastern HUC-8s have no potential intermittent stream credits.
- Five southwestern, northwestern, and northeastern HUC-8s have no potential ephemeral stream credits.

Maps of potential but unreleased stream and wetland credits can be found in Appendix A – Results.

Analysis of Credit Demand

Total purchases of wetland mitigation credits from mitigation banks that serve the Metropolitan Planning Area have fluctuated from year to year. In 2013, 505.3 wetland credits were purchased from banks that serve the region – the highest number of credits to be purchased per year dating to 1995. However, this number dropped to 105.75 in 2014. The transportation sector[5] is one of the two greatest purchasers of wetland and stream credits based on purchases dating to 1995 (Figure 5). Purchase data, available in RIBITS, were broken down by industry and year. Despite transportation's dominance, other

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[3] Mitigation bank service areas are based on HUC-8s. For a more detailed description of service area boundaries, see Appendix B – Methods.

[4] National Wetlands Inventory, National Land Cover Database, and Ecological Mapping Systems of Texas.

[5] For this analysis, the transportation sector included the forms of transportation addressed in Mobility 2040 including freight rail.

industries are emerging as purchasers of mitigation credits. The real estate and retail/business sectors have purchased an increasing number of credits since 2008 due to development associated with rapid population growth. The oil and gas industry is one of the two dominant users of wetland credits with the Barnett Shale natural gas field lying beneath North Central Texas. The industry's purchases have varied annually with a high of 204 wetland credits purchased in 2004. However, the oil and gas industry's purchases may be on the decline. The industry publication RigData reported zero active rigs in the Barnett Shale in late April 2016, down from a high of 194 rigs in September 2008 (Baker, 2016), and the oil and gas industry purchased 4.7 wetland credits during the first 11 months of 2015.

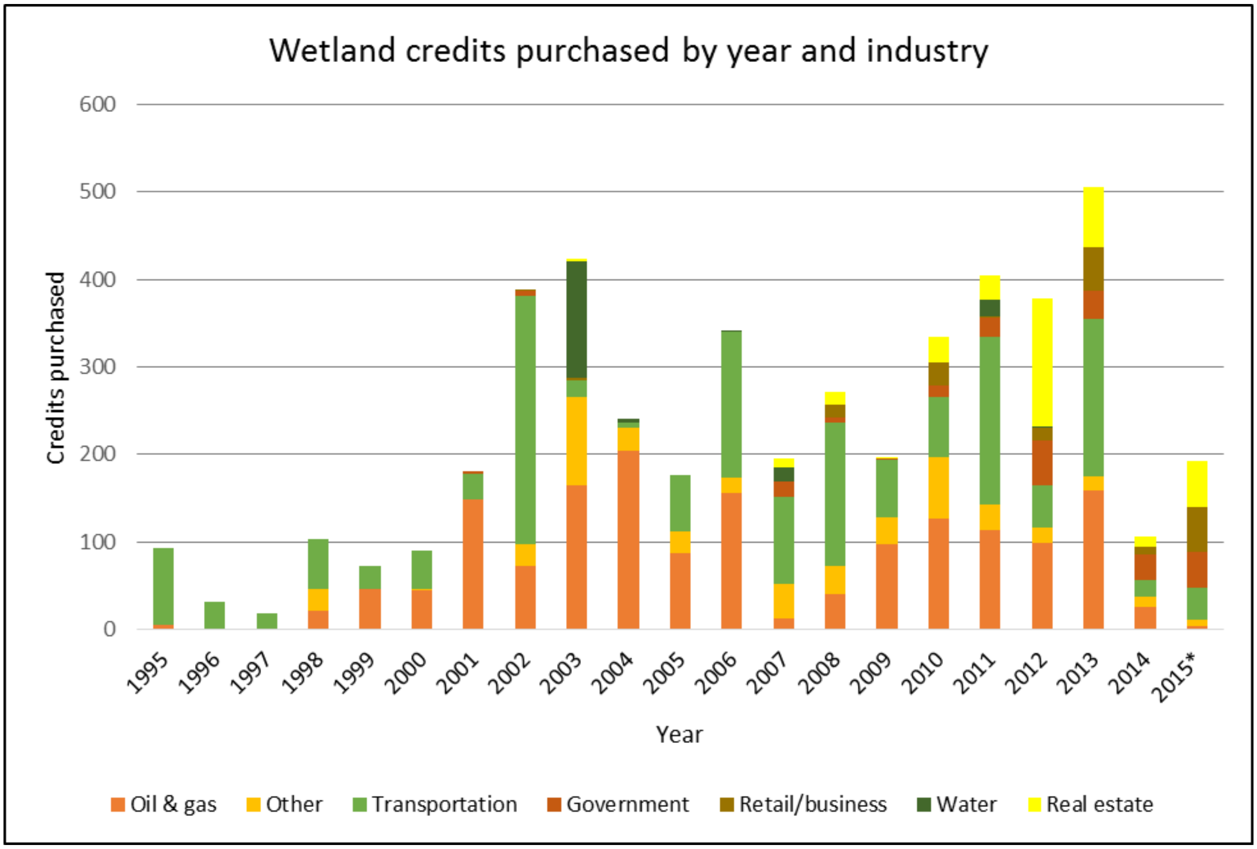


Figure 5: Wetland credits purchased by year and industry

Total purchases of stream credits were negligible before 2011. Like wetland credits, total purchases vary from year to year, but 2012 experienced a spike in purchases by the transportation industry which purchased 15,891.8 stream credits[6]. In contrast, the transportation industry purchased 3.9 stream credits in 2014. While the transportation industry is the largest user of stream mitigation bank credits over time, the real estate sector emerged as a leading user in 2013 (Figure 6). The industry's stream credit purchases have increased each year since 2011 with 2,701.8 stream credits purchased in 2015. Additional graphs illustrating industry purchases of wetland and stream credits can be found in Appendix A – Results.

[6] The city of Temple purchased more than 5,000 stream credits in 2012 related to the construction of Loop 363. The North East Texas Regional Mobility Authority purchased more than 10,000 credits in 2012.

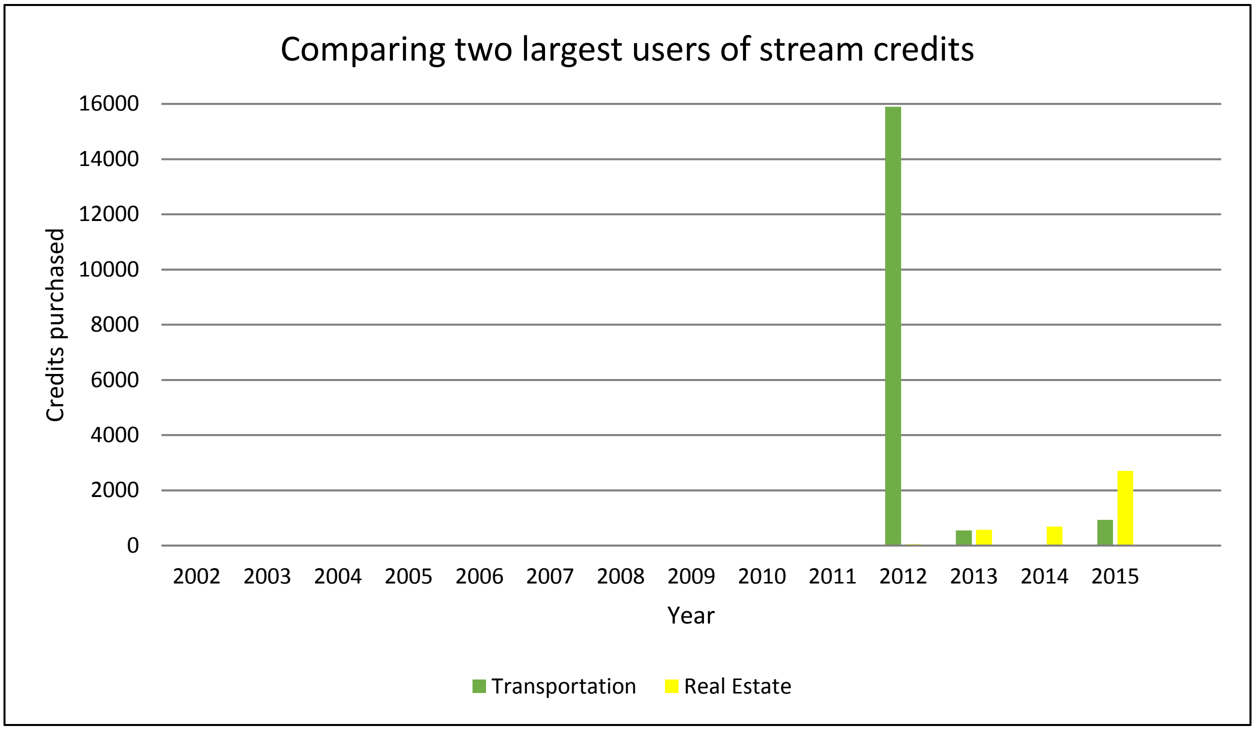


Figure 6: Comparing two largest users of stream credits

Stream credits have been purchased in larger numbers than wetland credits. Since 1995, 4,147.29 wetland credits have been purchased from banks serving North Central Texas, while 27,109.84 stream credits have been purchased since 2001. This occurred even though prior to 2013, stream impacts could be mitigated through wetland enhancement or upland buffer planting (USACE Fort Worth District, 2013). RIBITS data show that the average number of wetland credits purchased per permit is typically smaller than the average number of stream credits purchased per permit:

- The average wetland credit purchase per mitigation bank ranges from 0.8 credits to 14.7 credits.
- The region-wide average for wetland credit purchases is 5.6 credits.
- The average stream credit purchase per mitigation bank ranges from 3.6 credits to 2,704.7 credits.
- The region-wide average for stream credit purchases is 115.4 credits.

A table showing average wetland and stream purchases per bank can be found in Appendix A – Results.

The Mitigation Assessment also estimated the demand created by planned roadway projects expected to be completed by 2027 and 2040. Roadways were assigned low, medium, and high scores based on their estimated demand. After comparing this estimated demand to available and potential credits, the Mitigation Assessment found that several potentially high-impact projects were located in areas where stream credits may not be sufficient. The Mitigation Assessment also focused on ensuring supply of credits in the primary service area of planned roadway projects. Primary service areas are geographically closer and ecologically more similar to the site where the impact occurred than are secondary or tertiary service areas. For these reasons, permittees must purchase a greater number of credits when purchasing from secondary or tertiary service areas, leading to increased mitigation costs. By identifying sites that would produce credits in primary service areas where the greatest estimated demand exists, transportation partners can reduce mitigation costs.

Identifying Potential Mitigation Sites

The Mitigation Assessment used spatial data and geographic information system (GIS) models to identify potential mitigation bank sites. NCTCOG incorporated methods and data used by similar projects conducted by transportation agencies and conservation groups. The agency also sought input from stakeholders from the following agencies:

- USACE Fort Worth District Regulatory Division
- Texas Parks & Wildlife Department
- Natural Resources Conservation Service
- Texas A&M AgriLife Research
- NCTCOG Environment & Development Department

Maps illustrating potential mitigation sites can be found in Appendix A – Results, and the methods used to develop these maps can be found in Appendix B – Methods. This effort illustrated the complexities mitigation bankers face in identifying appropriate sites for mitigation banks.

Real Estate and Water Rights Requirements

Mitigation banking requires bank sponsors to fulfill real estate and water rights requirements that may not be needed for voluntary conservation projects or environmental stewardship.

Land used for wetland and stream mitigation banks must be conserved in perpetuity. In Texas, this is accomplished by placing the land in a conservation easement. Under conservation easements, land owners voluntarily reduce their property rights to develop and subdivide their land. Conservation easements can reduce the land's value, potentially lowering the landowners' taxes (Francell & Ferguson, 2009). The conservation easement must be held by a nonprofit organization such as a land trust or by a government resource agency such as the Texas Parks & Wildlife Department. The holder of the conservation easement must ensure that the property complies with the easement's requirements (The Environmental Law Institute and Land Trust Alliance, 2012). A long-term steward conducts the long-term management of the mitigation bank. This steward may also act as the steward of the conservation easement (The Nature Conservancy, 2016).

A conservation easement may be threatened if the owner of the property's mineral rights does not agree to the conservation easement because this owner must still have access to the land. Prior to acquiring land for a mitigation bank, the bank sponsor should acquire title reports that document encumbrances, mineral rights, or rights-of-way that may affect the site's ecological suitability (Denisoff, 2008). Land placed in a conservation easement also is not protected from condemnation or eminent domain (Texas Land Conservancy, 2015).

Mitigation banks located in the Fort Worth District of the USACE should either acquire water rights or be located upstream from a holder of senior water rights and downstream from a holder of junior water rights (personal communication, J. Walker, May 12, 2016). Since 1967, Texas has used a Prior Appropriation Doctrine for surface water rights; the system limits how landowners may use surface water without first receiving permission from the state (Texas Water Development Board, n.d.). The phrase "first in time first in right" applies to water rights in Texas. Water rights holders receive a priority date based on when they acquired water rights. Those with earlier dates are senior water rights holders, and their need for water must be met before the needs of junior water rights holders who have purchased their water rights more recently (Texas Commission on Environmental Quality, 2013). For example, during a drought, senior water rights holders may retain their ability to divert water, while junior water rights holders may lose their right.

The need to acquire water rights could delay the construction of a mitigation bank. In May 2016, the Texas Commission on Environmental Quality listed 341 pending applications for water rights (Texas Commission on Environmental Quality, 2016). Some applications date to 2002, indicating that it can take years to acquire water rights.

Financial Requirements

The USACE Fort Worth District requires mitigation bankers to provide short-term financial assurances that cover 110 percent of the costs to construct the mitigation bank. These costs include surveys, purchase of land, permits, building and plant materials, any construction work, monitoring of the site, legal and administrative costs, and others (USACE Fort Worth District, 2012). These financial assurances protect the USACE in case of project failure, although they are not held or managed by the USACE. Short-term financial assurances are held by a third-party designee such as a non-governmental organization or resource agency and are released in phases as the mitigation bank meets performance milestones. If these pre-determined milestones are not met, the financial assurances will be drawn upon to remediate the project. When construction of the mitigation bank is complete and its required monitoring and maintenance period is complete, the short-term financial assurances are released (Scodari, Martin, & Willis, 2011). The amount of financial assurances required depends on the size and complexity of the project, degree of completion at the time the project is approved, likelihood of success, and past performance of the project sponsor (USACE & USEPA, 2008).

The 2008 Final Rule outlined the types of allowable financial assurances which involve different risks, third parties, and upfront costs. Financial assurances for mitigation banking can be in the form of performance bonds, escrow accounts, casualty insurance, letters of credit, or legislative appropriations for government-sponsored projects. In recent years, letters of credits and performance bonds have become more difficult to obtain and casualty insurance is not commonly used (Scodari et al., 2011). The 2008 Final Rule states that the USACE district engineer may allow a government agency to provide a formal, documented commitment in lieu of short-term financial assurances (USACE & USEPA, 2008).

The mitigation banking instrument must describe plans to finance the long-term management or stewardship plan for the bank. The bank sponsor may transfer these responsibilities to a public agency, non-governmental organization, or private land manager. Bankers must estimate the annual cost of long-term management and select a funding mechanism (USACE & USEPA, 2008).

The Nature Conservancy developed a long-term stewardship calculator to help mitigation bankers and long-term managers estimate annual costs for maintaining mitigation banks and protecting conservation easements. These costs can include equipment, staff time, ecological monitoring, fencing, legal defense of the easement, and other costs (The Nature Conservancy, 2016). Management costs for smaller mitigation banks do not benefit from the economy of scale experienced by larger mitigation banks. Some expenses, such as permitting, are based on the project, not its size. Larger mitigation banks create a lower per-acre cost for these expenses and larger banks can benefit by selling more credits (Denisoff, 2008).

Long-term management funds are typically invested in a non-wasting endowment with stocks and bonds. The principal investment amount will be higher for sites that require higher annual maintenance costs, for endowments that generate lower nominal rates of return, or during times of higher inflation (The Nature Conservancy, 2016). A government entity that creates a mitigation bank and invests in a low-yield money market would need to invest a higher principal than a bank sponsor who could invest in a higher-yield investment (Denisoff, 2008). However, when a government agency serves as the long-term manager of a mitigation bank, the agency may develop a long-term financing plan instead of an endowment (USACE & USEPA, 2008).

Mitigation banking can be a risky investment. The business can “lack transparency, be inefficient, have high transaction costs, and is unknown to most investors” (Hook & Shadle, 2013, p. 10). Risks facing entrepreneurs include the extensive capital outlay that is required long before any returns, the difficulty of replacing key staff should they leave during a project, and the effort it takes to find suitable properties for projects. Privately backed bank sponsors are more equipped to take on these types of risks than public entities. Bankers can minimize or manage these risks by targeting USACE districts that favor mitigation banking, building relationships with regulators, and diversifying the locations of their banks and the kinds of credits their banks provide (Hook & Shadle, 2013).

Financing a mitigation bank is complex and the 2008 Final Rule favors mitigation sponsors who have a history of completing successful projects. A new entity that is interested in becoming a sponsor would need to dedicate several years before it would be ready to submit a mitigation instrument that meets the short- and long-term financial requirements of the USACE.

Recommended Actions

Efforts to ensure that mitigation credits are available can prevent project delays and save money. The Southwest Florida Water Management District estimated that advance planning for mitigation produced tax savings of more than $100 million compared with project-by-project mitigation planning (Southwest Florida Water Management District, 2016).

The Mitigation Assessment demonstrates that NCTCOG must take action to ensure that compensatory mitigation credits – particularly stream credits – are available so projects are not delayed. A lack of credits would require permittee-responsible mitigation which has been shown to delay permitting. From 2010 to 2014, the mean time to process individual and general permits was 57 days faster for projects mitigated through banks rather than through permittee-responsible on-site mitigation sites and 123 days faster than for permittee-responsible off-site mitigation sites (USACE Institute for Water Resources, 2015). Encouraging the development of mitigation banks in HUC-8s that are primary service areas for projects with high expected demand can provide less expensive mitigation. This is because impacts that occur in a mitigation bank’s primary service area require the purchase of fewer credits than impacts that occur in a mitigation bank’s secondary or tertiary service areas. For banks that serve the Dallas-Fort Worth area, credit ratios for tertiary service areas are typically 3:1, meaning mitigation costs could be three times more expensive than if primary service area credits were available (USACE, n.d.).

Future Research Needs

Steps could be taken in the future to improve the Mitigation Assessment’s ability to predict the demand on mitigation credits in the region.

Estimate credit demand with each metropolitan transportation plan: NCTCOG should repeat the supply and demand analysis with each new metropolitan transportation plan. This analysis should map available and potential credits and should estimate the level of credit demand generated by roadway projects in the shortest timeframe for which data are available. NCTCOG can reevaluate its need to become involved in mitigation banking based on these analyses. To supplement the supply and demand analysis, NCTCOG could gather information on proposed mitigation banks. The Fort Worth District of the USACE maintains a public notice Internet page where proposed mitigation banks are listed (USACE Fort Worth District, 2016). NCTCOG could glean information from these notices or request a full prospectus of any proposed mitigation bank that has gone up for public notice. NCTCOG local governments could join future Mitigation Assessments so their future land use and development plans could be accounted for in estimates of future credit demand.

Develop a shorter planning horizon: The Mitigation Assessment estimated impacts that would be created by the year 2040 and 2027; the latter is the shortest planning horizon included in Mobility 2040. During these 23-year and 11-year planning horizons, policy changes could affect mitigation requirements and credit availability will change as existing credits are sold and new banks potentially come online. In contrast to these planning horizons, the North Carolina Department of Transportation in-lieu fee arrangement mitigates for projects expected to be built in the next seven years (North Carolina Department of Environmental Quality, n.d.). The Florida Department of Transportation uses a planning horizon of a minimum of three years when communicating mitigation needs and its inventory of transportation projects is updated annually (Southwest Florida Water Management District, 2016).

NCTCOG could use projects included in the Transportation Improvement Program, a short-range planning document that describes projects funded for implementation over a three-year planning horizon. This would bring NCTCOG's projections of credit demands more in line with the planning horizon of mitigation bankers.

Improve the Mitigation Assessment method: The Mitigation Assessment could more accurately estimate the credit demand generated by transportation projects and better identify potential mitigation sites by addressing the following shortcomings of the current Mitigation Assessment:

- *Stakeholders*: While NCTCOG attempted to be as inclusive as possible, the Mitigation Assessment would have benefitted from additional stakeholders representing land trusts, nonprofit conservation groups, water districts, or river authorities. These stakeholders could have provided additional expertise regarding legal, financial, and real estate aspects of mitigation banking or may have already identified target areas for aquatic conservation.
- *Statistical analyses*: Statistics could be used to improve the GIS model that identified potential mitigation sites. A project conducted for the Nebraska Department of Roads used regression analyses to determine what combination of data layers best predicted the presence of wetlands when compared to wetlands identified by delineations (Burns & McDonnell, 2015).
- *Data limitations*: Shortcomings of spatial data may have limited the accuracy of the Mitigation Assessment. Hydric soils data showed an abrupt cutoff in value at the border between Dallas and Collin counties. Range data for protected species exists at the county level and does not represent observations of species, but instead whether the county contains habitat suitable for the animal. Existing wetlands varied between data sources with acreages of wetlands identified in the Dallas-Fort Worth region ranging from about 65,500 acres to 103,500 acres depending on the source. Widths of streams were unknown so impacts could not be quantified. NCTCOG staff found they could use neither stream category (perennial, intermittent, or ephemeral) nor stream order as an accurate surrogate for width. No ephemeral streams spatial data are available for the region.

- *Methodology limitations*: The method to estimate potential credit demand generated by impacts to wetlands and streams also had limitations because aquatic resource data vary, do not exist, or do not include information on the quality of the aquatic resource. Roadway widths are estimations based on the TxDOT Roadway Design Manual (TxDOT, 2014). Without true quantifications of impacts, the Mitigation Assessment cannot determine whether impacts will meet the threshold to require compensatory mitigation. See Appendix B – Methods for an outline of mitigation thresholds for linear transportation projects. The Mitigation Assessment may underestimate or overestimate credit demand generated by the roadway projects in Mobility 2040. Jurisdictional determinations for completed roadway projects in the region show that for one project permitted in 2008, ephemeral impacts measured in channel length were as high as 39.18 percent of all stream impacts (USACE Fort Worth District, 2009). By excluding ephemeral streams, the Mitigation Assessment could underestimate impacts. The Mitigation Assessment also may underestimate total demand on credits by not accounting for permittee-responsible sites created where no mitigation credits were available. In contrast, the Mitigation Assessment could overestimate credit demand because the actual alignment for the Mobility 2040 roadway projects will be identified later in the planning process and impacts to aquatic resources could be avoided or minimized. The Mitigation Assessment also sums potential impacts for the portions of roadways as they fall within HUC-8s, rather than analyzing single and complete linear transportation projects and their separate and distinct crossings of aquatic resources as described by Nationwide Permit 14 (USACE, 2012).
- *Credit determinations*: The Texas Rapid Assessment Method 2.0 and other functional assessment methods used by the USACE Fort Worth District calculate impacts not only on areas impacted but also on the quality of the aquatic resource being impacted. The district includes the ecological lift created at the mitigation bank in calculations to determine the number of credits the mitigation bank may sell. The Mitigation Assessment cannot replicate this; however, it overlays estimates of potential roadway impacts on appropriate Regional Ecosystem Framework (REF) layers to provide a conceptualization of quality. The data that underlie the REF measure quantity, not quality, of the factors. However, stakeholders believed that a high quantity of a factor could correlate with quality to some extent.
- *Supply and demand overlay*: The Mitigation Assessment would benefit by conducting a quantitative analysis by overlaying the low, medium, and high estimates of credit demand on maps of available credits. This could better identify HUC-8s where credits shortages exist.

Recommended Solution

NCTCOG's Mitigation Assessment determined that shortcomings in stream mitigation credits in the Dallas-Fort Worth region's rapidly growing northern counties may delay the permitting and construction of transportation projects recommended by Mobility 2040. These delays and the potential need for permittee-responsible mitigation could increase the cost of compensatory mitigation for these projects.

Texas state law does not allow NCTCOG to sponsor a mitigation bank. The Texas Natural Resources Code allows Harris County, counties adjacent to Harris County, state agencies, and conservation and reclamation districts to use money to establish or maintain a mitigation bank. Counties and conservation and reclamation districts must gain approval from the county commissioners of each county the subdivision is located in to "institute a wetland regulation program." The state and eligible political subdivisions may issue bonds, notes, or obligations to fund a mitigation bank (Natural Resources Code, 1997).

While NCTCOG cannot sponsor its own mitigation bank, the agency should take several steps to ensure that credits are available and are cost-effective:

- The Regional Transportation Council, which serves as the policy body for the region's Metropolitan Planning Organization, should adopt a policy that requires mitigation credits be purchased from a primary service area when a bank in that area can supply credits that meet the requirements of the USACE. This step could reduce costs and ensure that compensatory mitigation takes place in the same watershed where impacts occur.
- NCTCOG should explore what benefits would be gained if the agency or transportation partners were to provide payments to mitigation bankers earlier than when mitigation credits would be purchased. These early payments could give mitigation bankers a better opportunity to respond to the demand generated by transportation projects recommended by long-range transportation plans.
- Transportation planning partners should seek information on what information mitigation bankers and environmental consultants would need before they would consider constructing a mitigation bank in the region. This could be accomplished by issuing a Request for Information and hosting a forum open to all mitigation bankers and environmental consultants interested in developing mitigation credits in the region. This forum should create a level playing field for all interested bankers and consultants.

Precedent exists for coordination between mitigation bankers and infrastructure planners and implementers. The North Carolina Department of Environmental Quality Division of Mitigation Services releases a Request for Proposal describing its mitigation credit needs each year. Existing mitigation banks can submit proposals to sell their released and unreleased credits to fulfill these needs (North Carolina Department of Environmental Quality, n.d.). The Port of San Diego sought to meet its mitigation needs by issuing a Request for Proposals for developers or consultants to establish a mitigation site on property already identified by the Port (Unified Port of San Diego, 2015).

Benefit of Enacting Solution

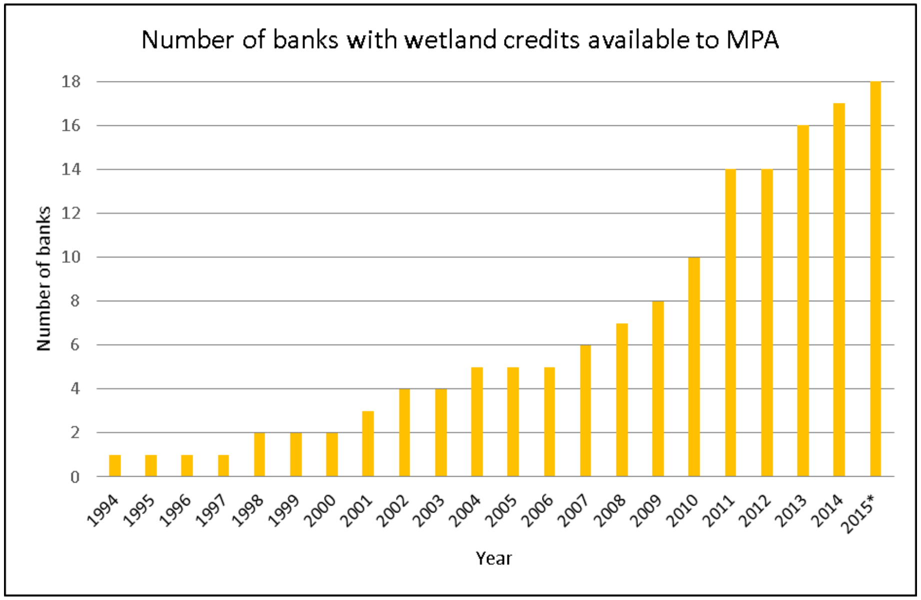
Coordination between NCTCOG and mitigation bankers can benefit the agency, the bankers, the environment, and NCTCOG's transportation partners and member local governments. NCTCOG can prevent delays in permitting and construction and can reduce the cost of compensatory mitigation by communicating the agency's need for mitigation bank credits to existing and potential mitigation bankers.

Mitigation bankers will be more likely to establish banks where they know a demand exists. This demand lowers the bankers' risk that credits will not be purchased. By communicating the construction timeline for transportation projects, NCTCOG can allow bankers to strategically shorten the time between their outlay of capital and their return on investment. If bankers use the GIS model created by the Mitigation Assessment to guide their selection of mitigation sites, they can protect sites that best provide wildlife habitat, address poor water quality, or alleviate flooding. By producing credits in the same HUC-8 where impacts occur, mitigation banks can best compensate for negative effects in the watershed. NCTCOG could include member cities' future land use plans in estimates of credit demand. If banks provide credit to meet these additional demands, cities and transportation project developers would not face limits created by a lack or high cost of mitigation credits.

Mitigation Assessment Appendix A — Results

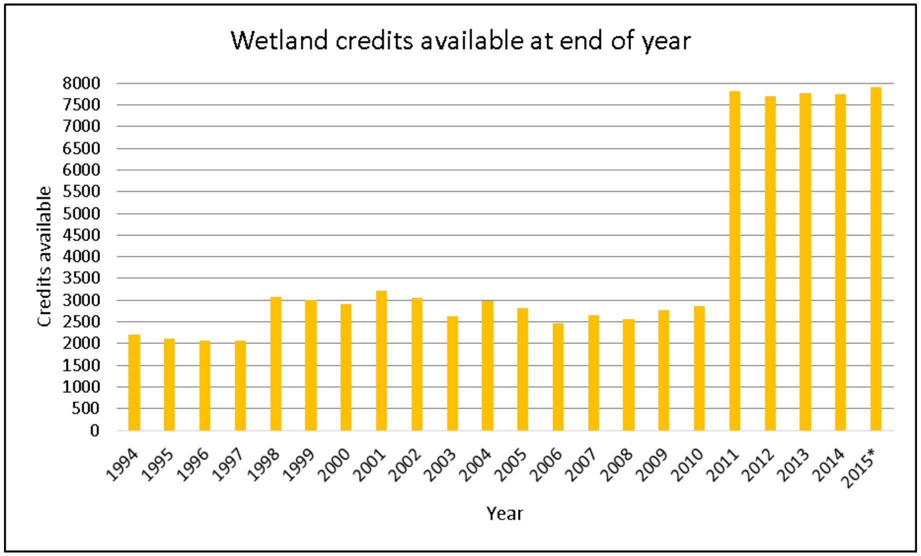
Mitigation Assessment Appendix A — Results

Quantifying Supply of Wetland and Stream Mitigation Credits



*Through November 2015

Figure A.1 Wetland mitigation banks



*Through November 2015

Figure A.2 Available wetland credits per year

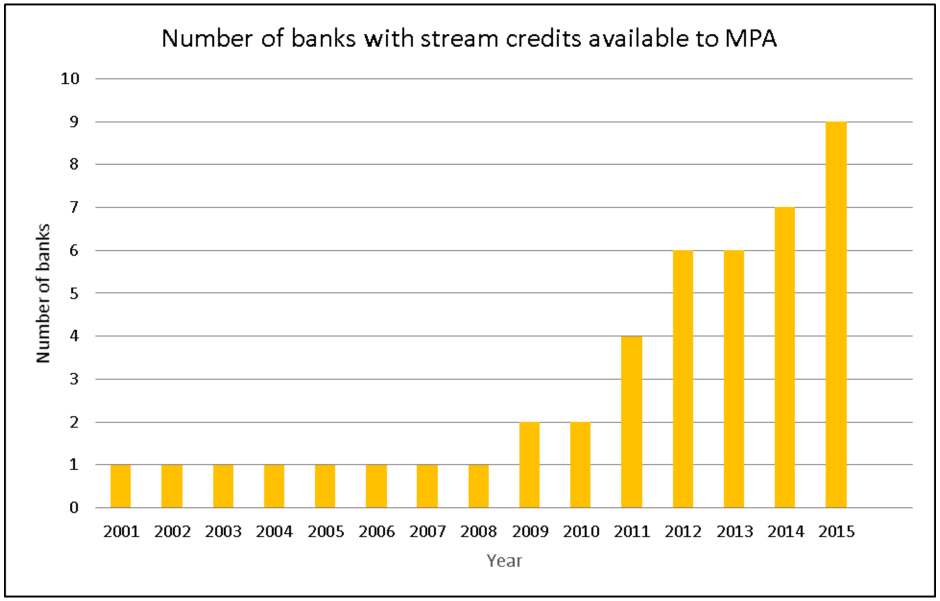


Figure A.3 Stream mitigation banks

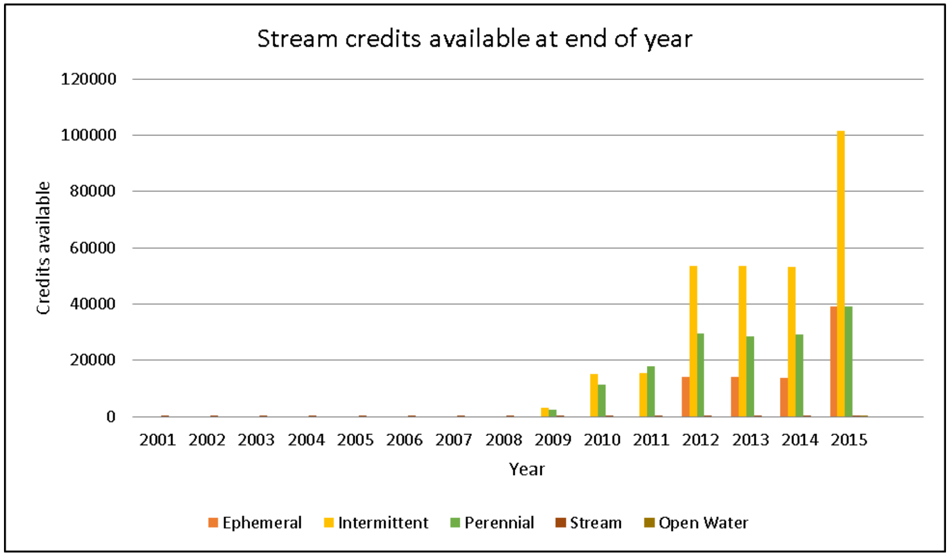
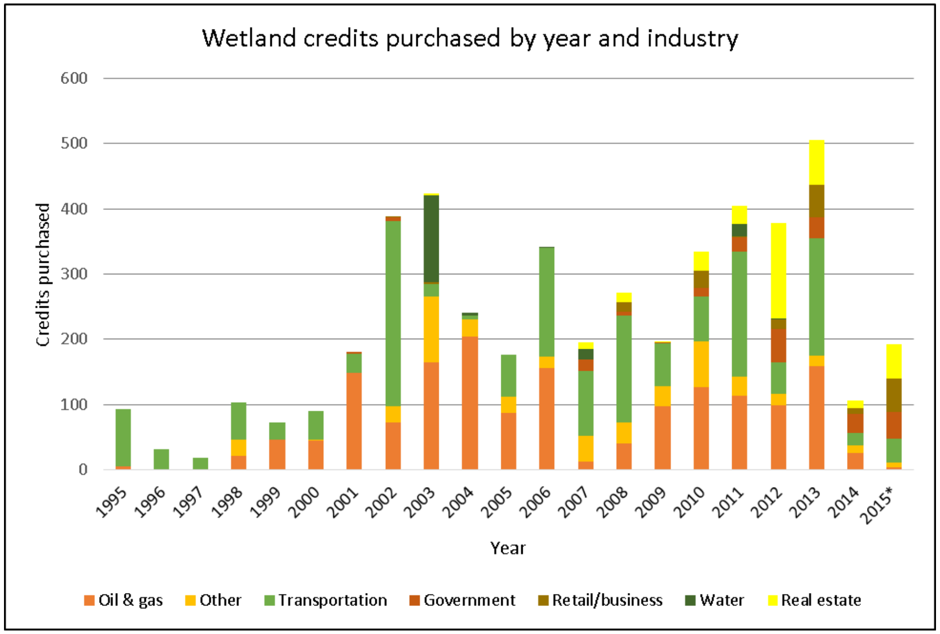


Figure A.4 Available stream credits per year

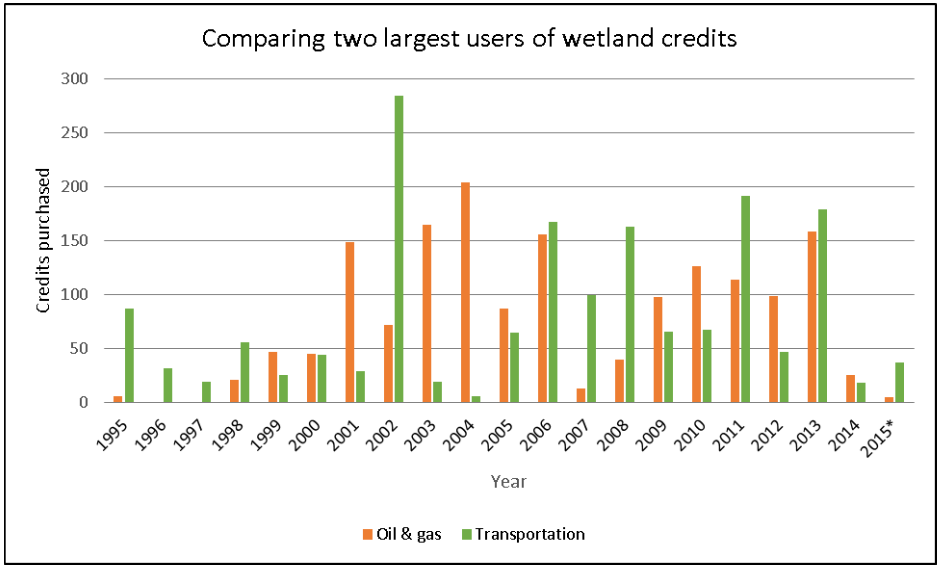
Quantifying Demand on Wetland Mitigation Credits

The data identify the industries that have purchased the greatest number of credits and those whose credit purchases have increased in recent years. This information identifies future potential competition for credits. For example, the oil & gas sector is the second-largest purchaser of wetland credits over time. However, low oil prices and a shift to natural gas drilling in other parts of the United States may be reflected in the reduced wetland credit purchases in 2014 and 2015. Real estate may be emerging as the transportation sector's greatest competitor for these credits.



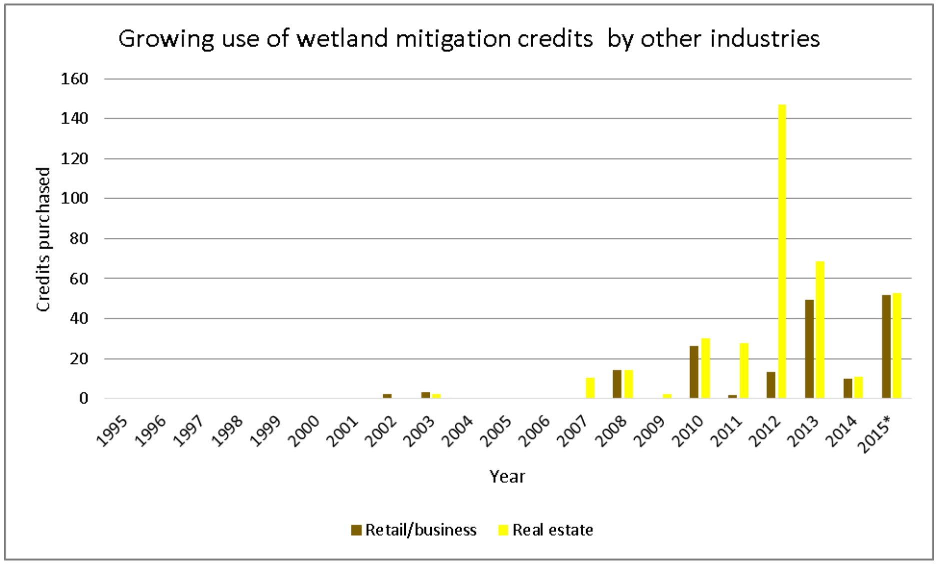
*Through November 2015

Figure A.5 Purchasers of wetland credits



*Through November 2015

Figure A.6 Dominant purchasers of wetland credits



* Through November 2015

Figure A.7 Other purchasers of wetland credits

The data identify the industries that have purchased the greatest number of credits and those whose credit purchases have increased in recent years. This information identifies future potential competition for credits. For example, the real estate sector is the second-largest purchaser of stream credits over time, and has been the largest purchaser of stream credits since 2013. Because the population in the region is expected to grow from about 7 million to more than 10 million by 2040, more land will be developed, creating more competition for stream credits.

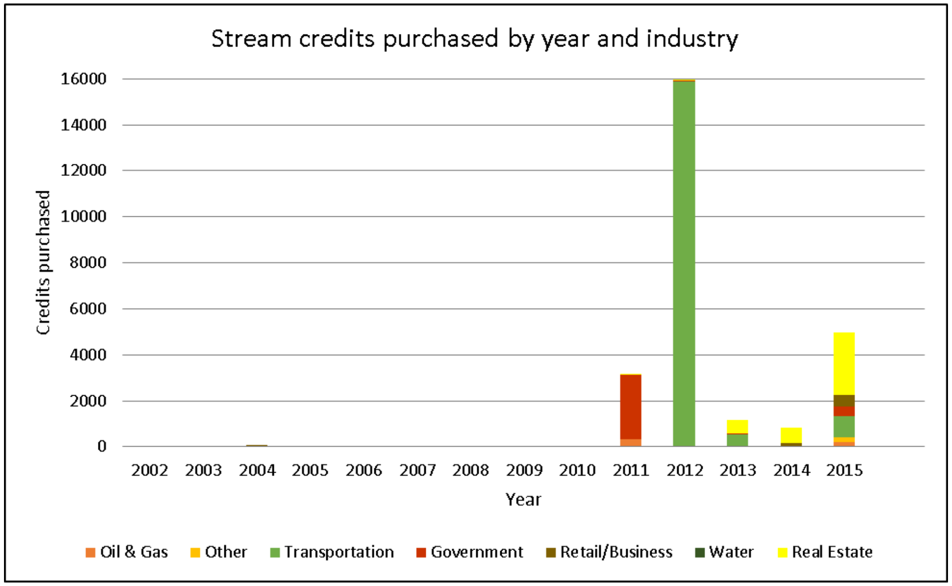


Figure A.8 Stream credits purchased

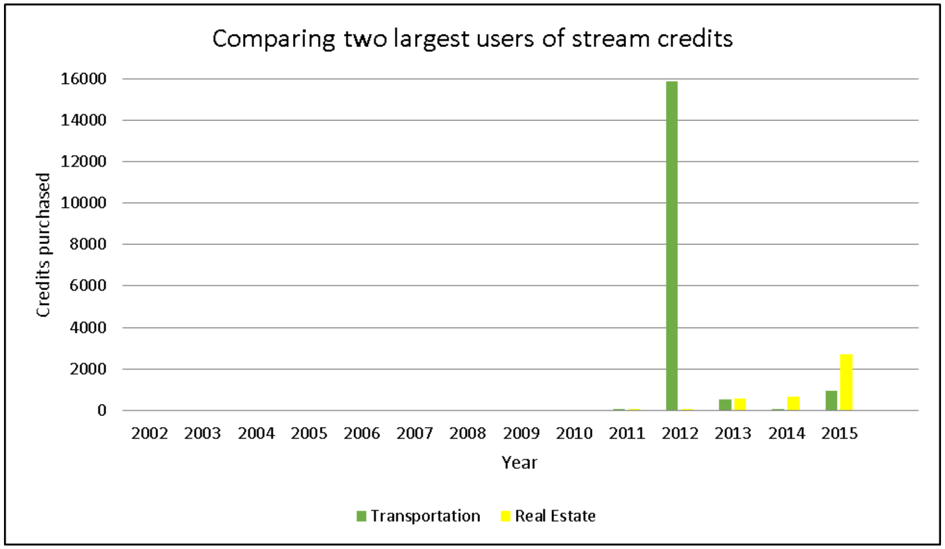


Figure A.9 Dominant purchasers of stream credits

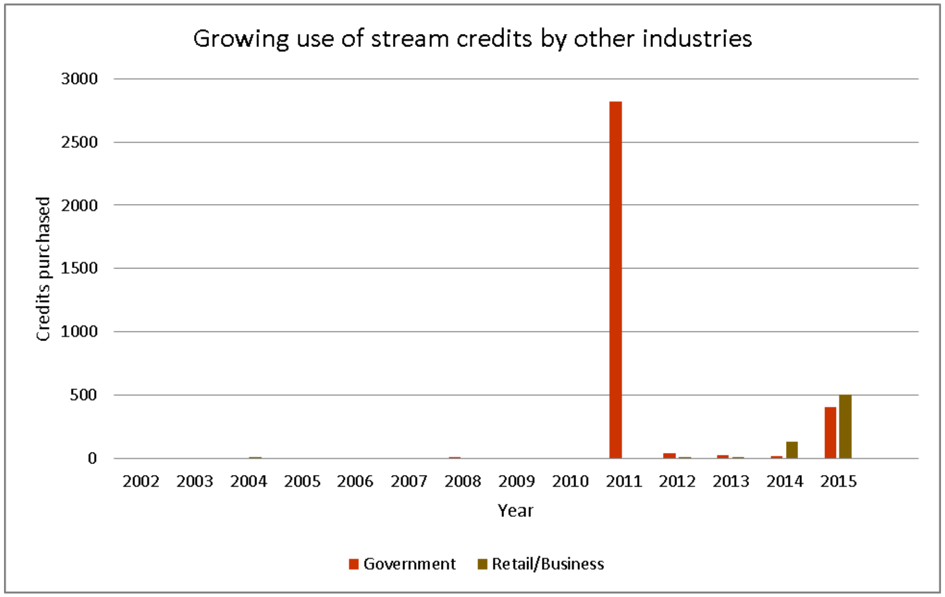


Figure A.10 Historical use of stream credits

Comparing Average Credit Purchases for Wetland and Stream Mitigation Credits

Credit ledger data were used to compare the average credit purchase for wetland credits versus stream credits. This showed that while there are fewer stream purchases, in some part because prior to 2013 stream impacts could be mitigated with wetland credits, the average stream credit purchase is more than 20 times that of wetland credit purchases.

	Wetlands			Streams		
Bank	**Credits Withdrawn**	**No. Withdrawals**	**Average**	**Credits Withdrawn**	**No. Withdrawals**	**Average**
Anderson	1354	92	14.7	27	4	6.8
Big Woods on the Trinity	232.8	22	10.6	N/A	N/A	N/A
Brooks Creek	37.75	18	2.1	N/A	N/A	N/A
Bunker Sands	162.6	49	3.3	N/A	N/A	N/A
Burleson Wetlands	4.7	3	1.6	0	0	0
Daisy	0.8	1	0.8	1222	5	244.4
Edmore Creek	0	0	0	N/A	N/A	N/A
Fall-Off Creek	N/A	N/A	N/A	5480	2	2740
KLAMM*	1139	252	4.5	N/A	N/A	N/A
Keystone	105.3	51	2.1	N/A	N/A	N/A
Mill Branch	N/A	N/A	N/A	3529.51	35	100.8
Murvaul Creek	0	0	0	N/A	N/A	N/A
OXBOW	0	0	0	N/A	N/A	N/A
Patroon Bayou	159.1	69	2.3	13523.4	5	2704.7
Red Oak Umbrella	0	0	0	130.6	1	130.6
Rockin' K on Chambers Creek	0	0	0	2593.08	14	185.2
South Forks Trinity River	358.4	62	5.8	N/A	N/A	N/A
South Forks TR Ten Mile Creek	61.4	5	12.3	N/A	N/A	N/A
Steele Creek	165.8	25	6.6	N/A	N/A	N/A
Trinity River	365.64	92	4.0	604.25	169	3.6
Wet Unlimited	0	0	0.0	N/A	N/A	N/A
Totals	**4147.29**	**741**	**5.6**	**27109.84**	**235**	**115.4**

* -32 credits returned in 2 transactions; Chevron USA -31 and Anadarko E&P -1
Data Downloaded 1/29/16

Table A.1 Average wetland and stream credit purchases

Discussion of Available Credits

Maps displaying available credits for wetlands and streams appear on pages A7-A31. All wetland classifications have been combined. The Fort Worth District of the U.S. Army Corps of Engineers uses its Stream Mitigation Method to dictate what types of credits permittees must purchase. The method classifies streams based on the frequency water flows through them and the source of that water. The method classifies mitigation credits by the type of work that was done to generate the ecological enhancement, known as ecological lift. The Texas Rapid Assessment Method (TXRAM) Wetland and Streams Modules (Version 2.0) describes the following stream types and credit types (USACE Fort Worth District, 2015):

Stream types

Perennial: Typically contain water that flows year round; draw their flow primarily from groundwater; impacts to perennial streams must be mitigated with perennial stream credits.

Intermittent: Typically contain water that flows seasonally; draw their flow from groundwater and rainfall runoff; impacts to intermittent streams must be mitigated with intermittent stream credits.

Ephemeral: Typically contain water that flows temporarily and only after precipitation occurs; draw their flow primarily from rainfall runoff; impacts to ephemeral streams may be mitigated with ephemeral or intermittent stream credits.

Credit types

The following credit types exist for each stream type:

In-channel credits: Generated by ecological lift associated with channel condition, in-stream condition, and hydrologic condition. The Stream Mitigation Method requires 50 percent of all mitigation credits purchased to be in-channel credits, if they are available.

- Channel condition refers to the height and angles of the stream's banks and its ability to flood naturally.
- In-stream condition refers to the type, quantity, and diversity of the material that composes the bed of the stream (such as gravel, sand, and woody debris). It also refers to the quantity and quality of habitat within the stream.

A common buttonbush growing at the Fort Worth Nature Center & Refuge. This obligate wetland shrub is suitable for wetland restoration, according to the Natural Resources Conservation Service.

- Hydrologic condition refers to the presence of flowing water, the presence of deeper pools of water in some parts of the stream, and the presence of water traveling within the bed of the stream.

Riparian buffer credits: Generated by ecological lift associated with the condition of the buffer area that borders the stream. This can be accomplished through planting native vegetation and trees that will provide shape, prevent erosion, and trap pollutants. Humans and domestic animals are typically prevented from accessing areas where riparian buffers have been created for mitigation.

General stream or legacy credits: Generated by ecological lift created by means other than in-channel or riparian work. These are credits that were approved and/or constructed prior to the 2013 implementation of the Stream Mitigation Method. Their use to compensate for impacts to streams has been grandfathered in. Some of these credits were created by enhancing or restoring wetlands or by planting trees farther from the stream than its riparian buffer.

Discussion of Available Credits

Wetlands

Hood County and western Parker County have zero credits in any service area. The same areas and southwestern Johnson County have zero credits in their primary service area. The rest of the region has at least 418 to as many as 6,810 credits in any service area and at least 147 to as many as 6,099 credits in primary service areas.

Perennial Streams

In-channel credits: Southwestern and eastern portions of the Dallas-Fort Worth region have zero credits in any service area, and south-central portions have fewer than 200 credits in any service area. In contrast, much of Hunt County has about 3,000 credits in any service area. Much of the region has zero credits in primary service areas, while Hunt County again has about 3,000 credits in a primary service area.

Riparian buffer credits: Wise and Hood counties and parts of Parker, Johnson, and Hunt counties have zero credits available in any service area. Much of the region has zero credits available in primary service areas, though portions of Dallas, Ellis, and Kaufman counties have more than 700 credits.

Legacy stream credits: Much of the region has zero credits available in any service area, though portions of Hunt, Parker, and Hood counties have more than 1,500 credits in any service area. No part of the region has any credits available in a primary service area.

Intermittent Streams

In-channel credits: The northern, southwestern, and eastern portions of the region have zero credits available in any service area. Ellis County and portions of Tarrant, Parker, Dallas, Johnson, and Kaufman counties have 861 credits available in any service area. Much of the region has zero credits available in primary service areas. However, portions of Johnson and Ellis counties have more than 800 credits available in primary service areas.

Riparian buffer credits: Almost the entire region has zero credits available in primary or any service areas. One credit is available in portions of Ellis and Johnson counties in a primary service area.

Legacy stream credits: Wise County and portions of several other counties have zero credits available in any service area. Much of the central portion of the region has 595 credits available in any service area. Portions of Hunt, Kaufman, Parker, and Hood counties have more than 8,000 credits available in any service area. Portions of Ellis, Kaufman, Dallas, and Collin counties have 595 credits available as a primary service area.

Ephemeral Streams

In-channel credits: The northern, eastern, and southwestern portions of the region have zero credits available in any service area. In contrast, portions of Parker, Tarrant, Johnson, Ellis, Dallas, Collin, and Kaufman counties have more than 2,800 credits available in any service area. Much of the region has zero credits available in primary service areas, though portions of Johnson and Ellis counties have more than 2,800 credits available in primary service areas.

Riparian buffer credits: The northern, eastern, and southwestern portions of the region have zero credits available in any service area. Ellis County and portions of Parker, Tarrant, Johnson, Dallas, Collin, and Kaufman counties have 106 credits available in any service area. Much of the region has zero credits available in primary service areas, though portions of Johnson and Ellis counties have 106 credits available in primary service areas.

Legacy stream credits: Wise County, much of Hunt County, and portions of northern and southwestern counties have zero credits available in any service area. In contrast, much of the central portion of the region has more than 6,400 credits available in any service area, and portions of Parker and Hood counties have more than 29,000 credits available in any service area. While much of the region has zero credits available in primary service areas, portions of Ellis, Kaufman, Dallas, and Collin counties have more than 6,400 credits available in primary service areas.

Other

General legacy stream credits: Hunt, Parker, and Hood counties have zero credits available in any service area. The region's other counties have 172 credits available in any service area. The same counties, and portions of Collin, Rockwall, Kaufman, and Johnson counties, have zero credits available in primary service areas. The rest of the region has 172 credits available in primary service areas.

General stream credits: One credit is available in a primary service area that serves much of Hunt County and portions of Collin, Rockwall, and Kaufman counties. However, this credit is only available for TxDOT projects.

Available Wetland Mitigation Credits, Combined Service Areas

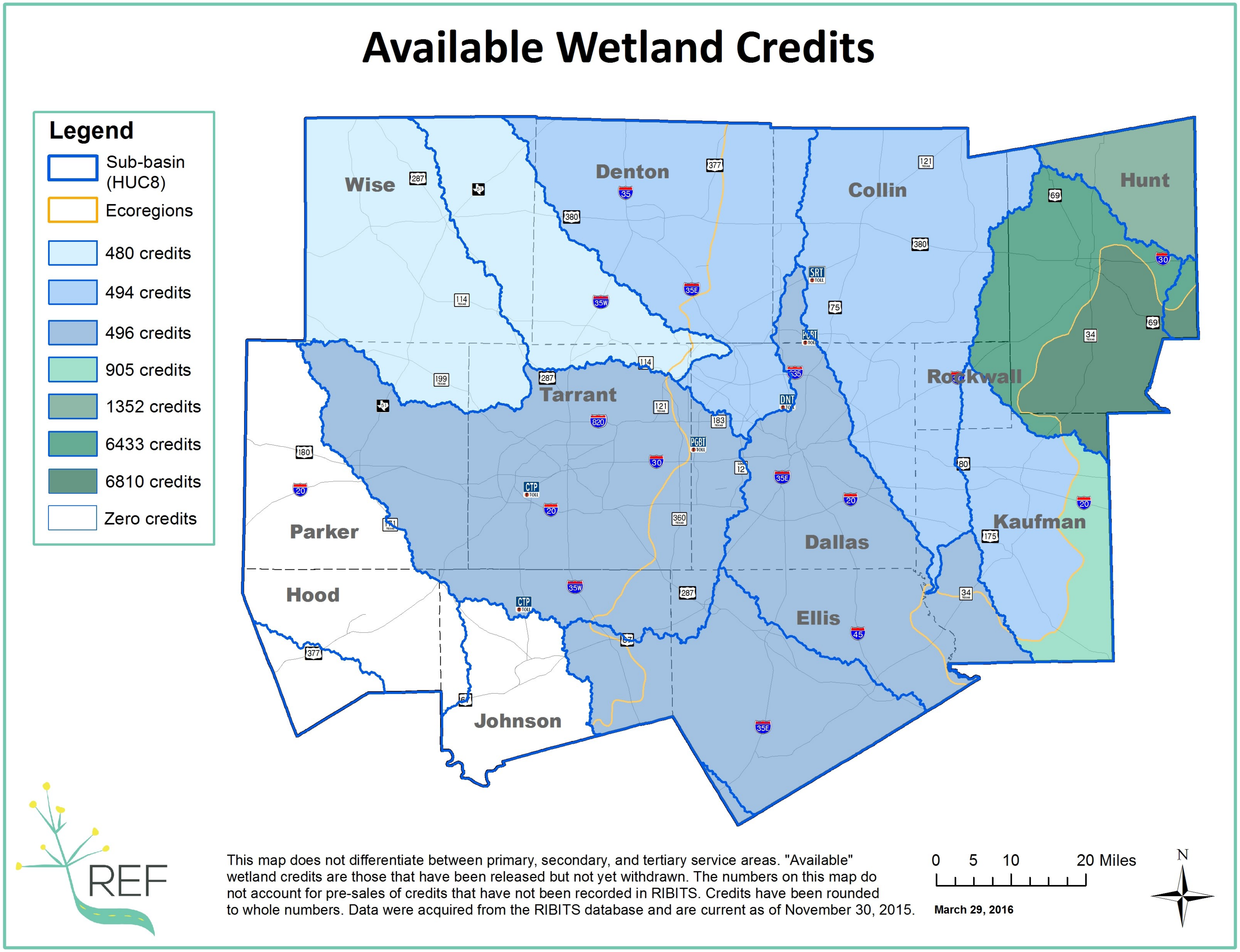


Figure A.11 Available wetland mitigation credits, combined service areas, available wetland credits

Available Wetland Mitigation Credits, Combined Service Areas, Trinity River Mitigation Bank

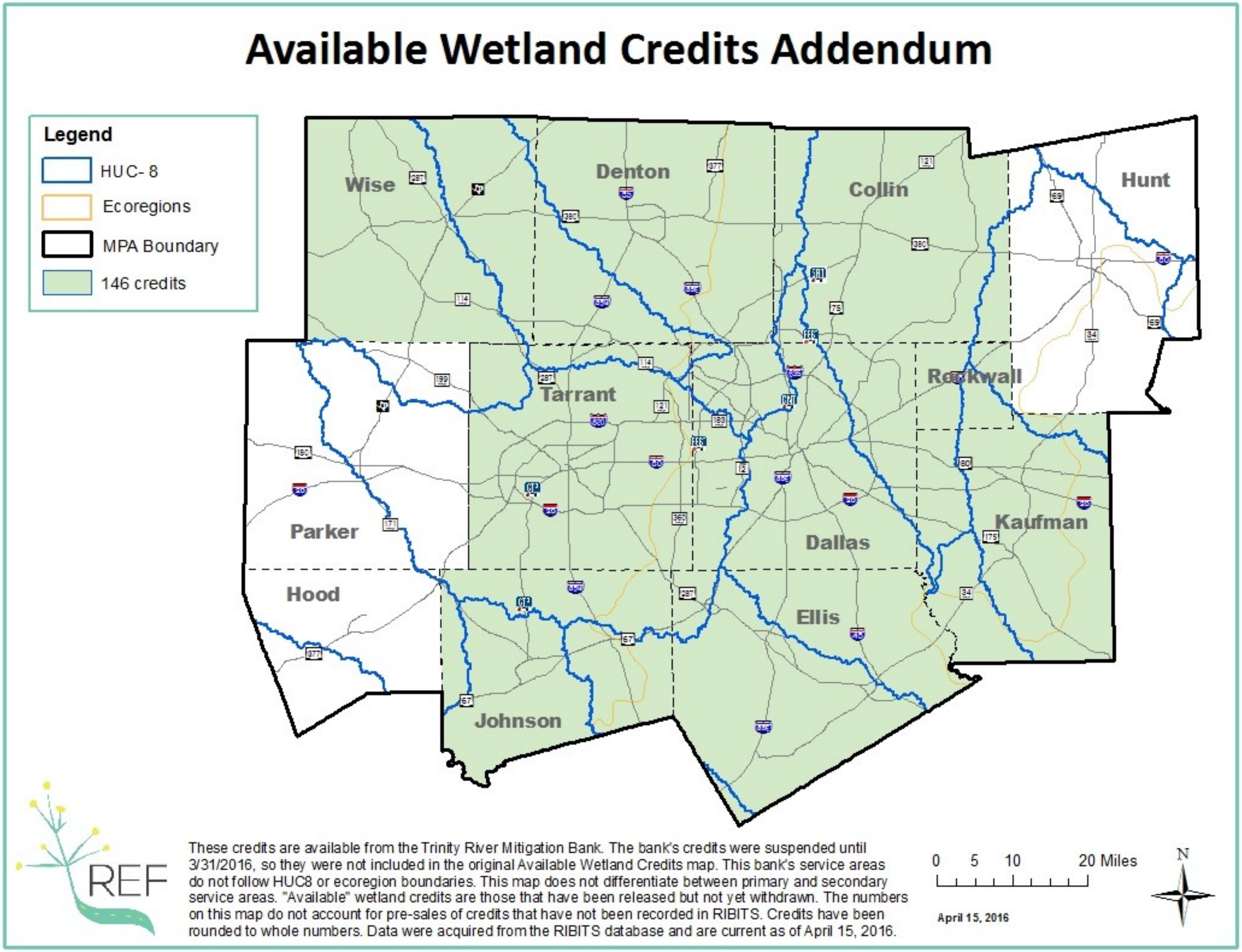


Figure A.12 Available wetland mitigation credits, combined service areas, Trinity River Mitigation Bank, available wetland credits addendum

Available Wetland Mitigation Credits, Primary Service Areas

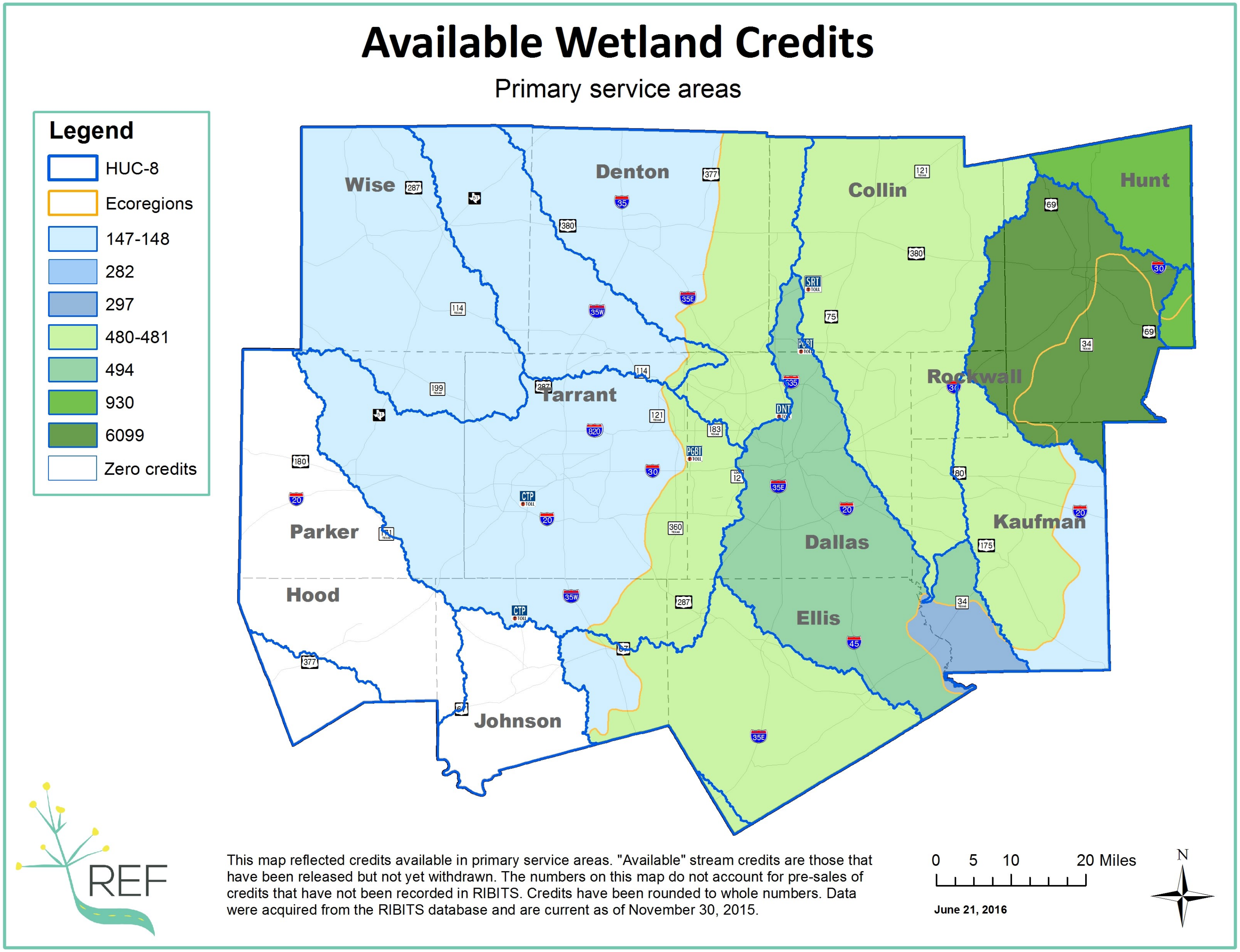


Figure A.13 Available wetland mitigation credits, primary service areas

Available Wetland Mitigation Credits, Primary Service Areas, Trinity River Mitigation Bank

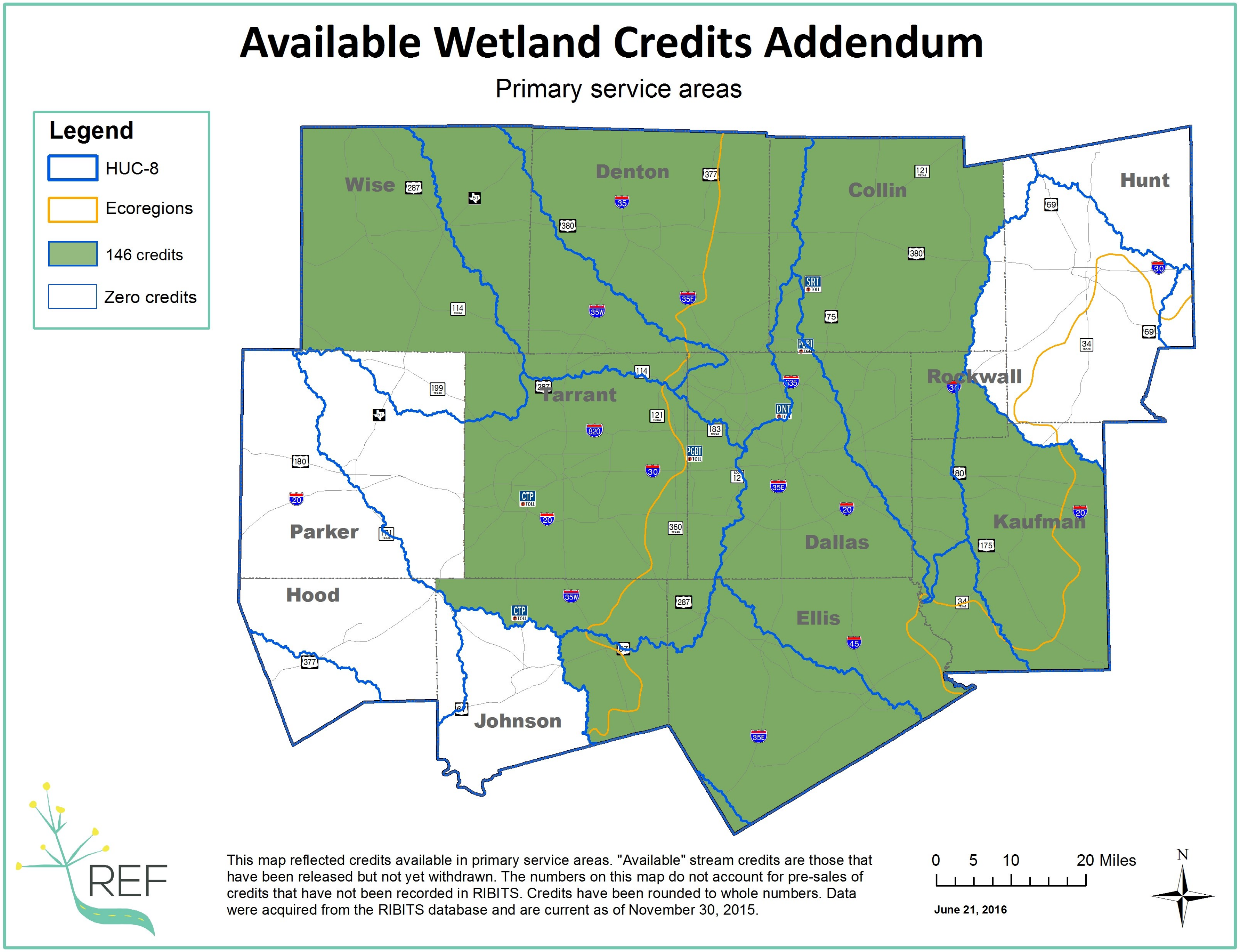


Figure A.14 Available wetland mitigation credits, primary service areas, Trinity River Mitigation Bank

Available Stream Mitigation Credits, Combined Service Areas

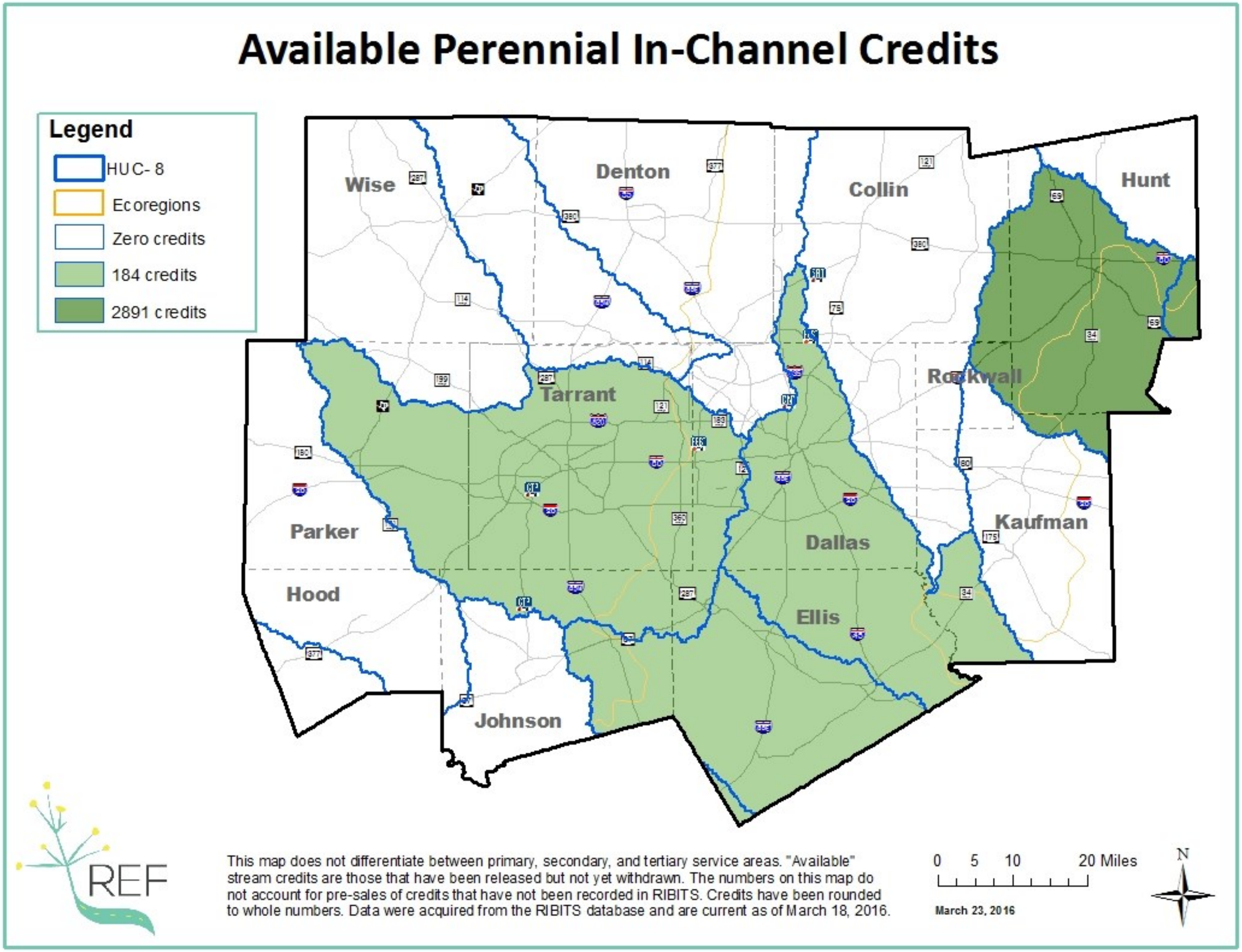


Figure A.15 Available stream mitigation credits, combined service areas, available perennial in-channel credits

Available Stream Mitigation Credits, Combined Service Areas

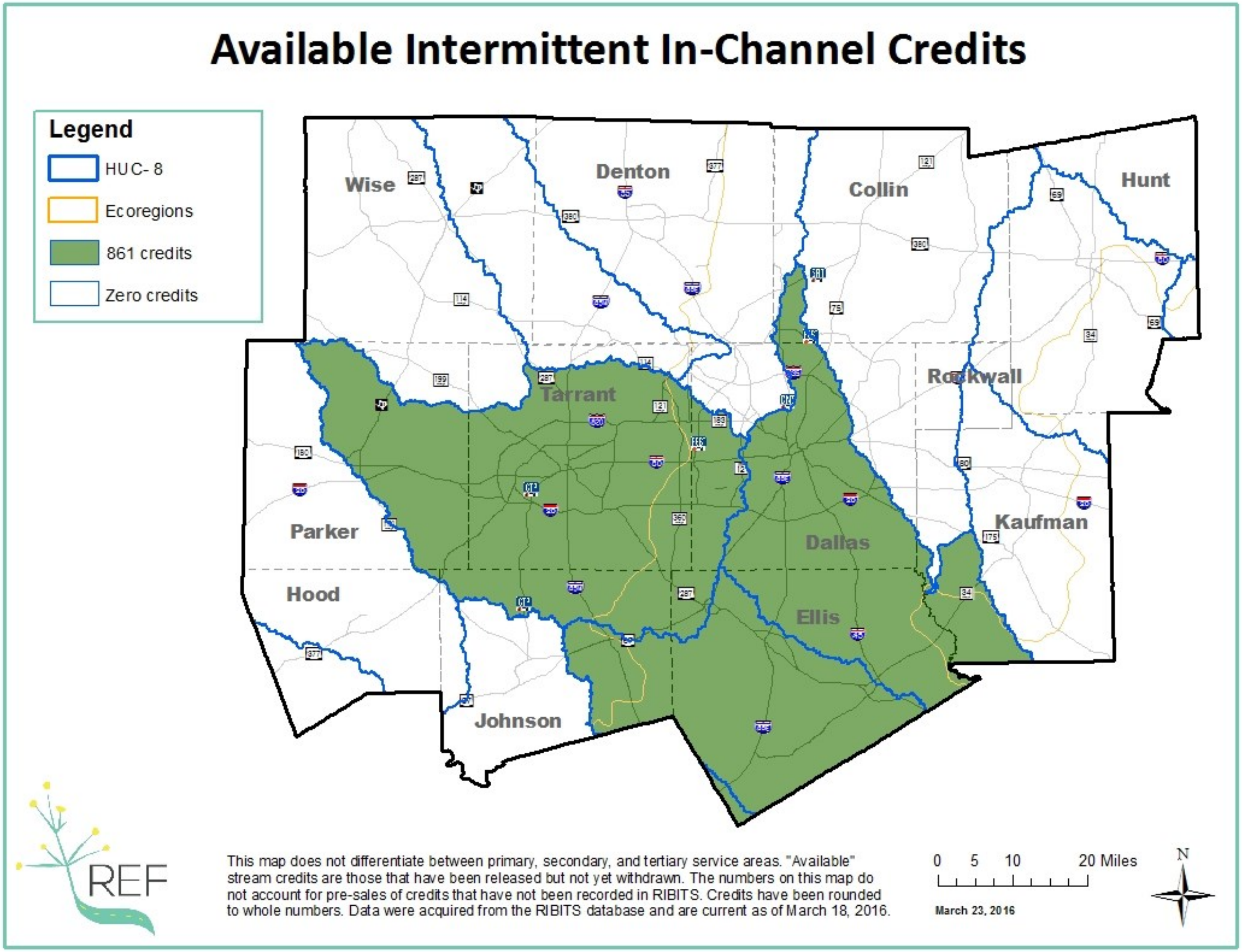


Figure A.16 Available stream mitigation credits, combined service areas, available intermittent in-channel credits

Available Stream Mitigation Credits, Combined Service Areas

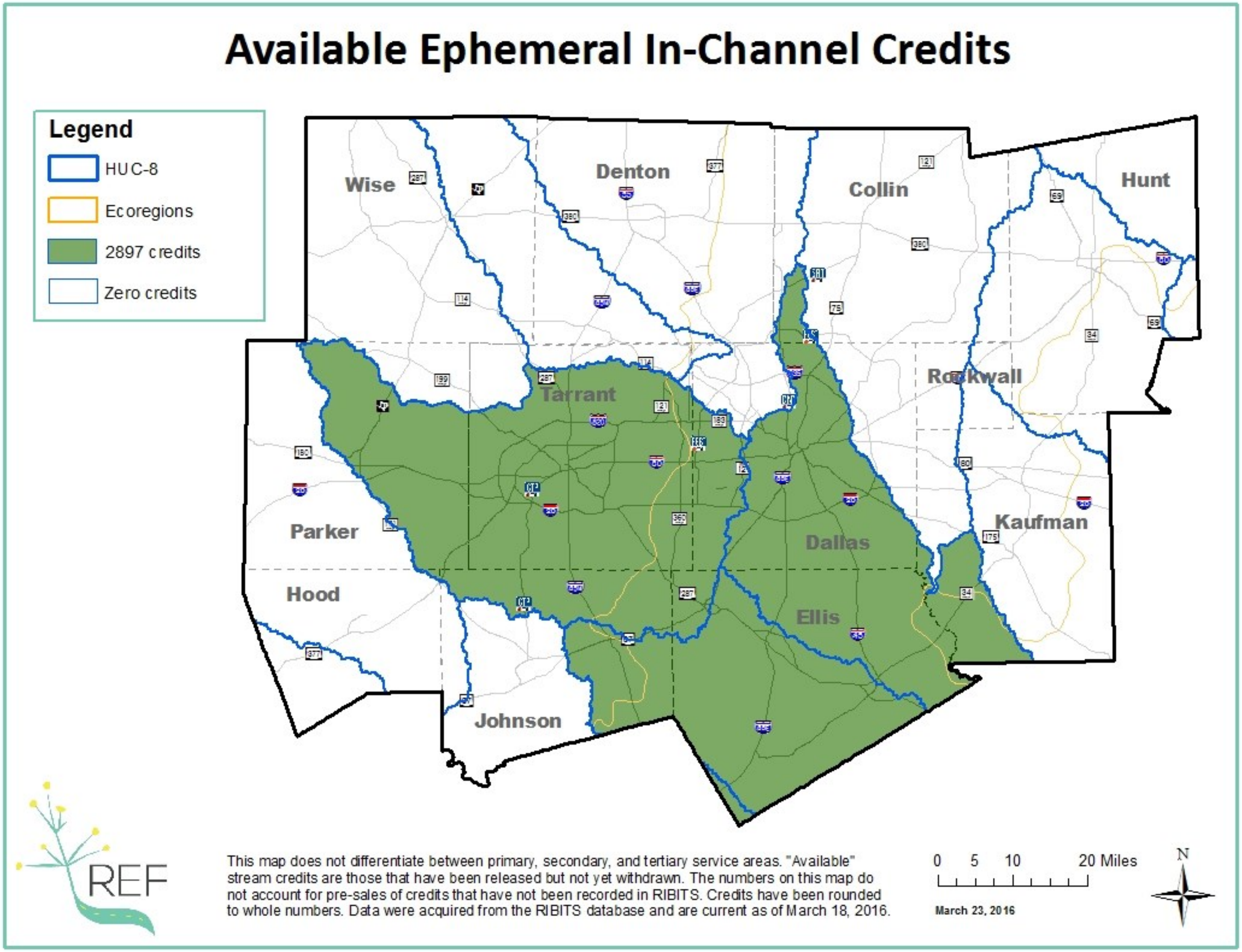


Figure A.17 Available stream mitigation credits, combined service areas, available ephemeral in-channel credits

Available Stream Mitigation Credits, Combined Service Areas

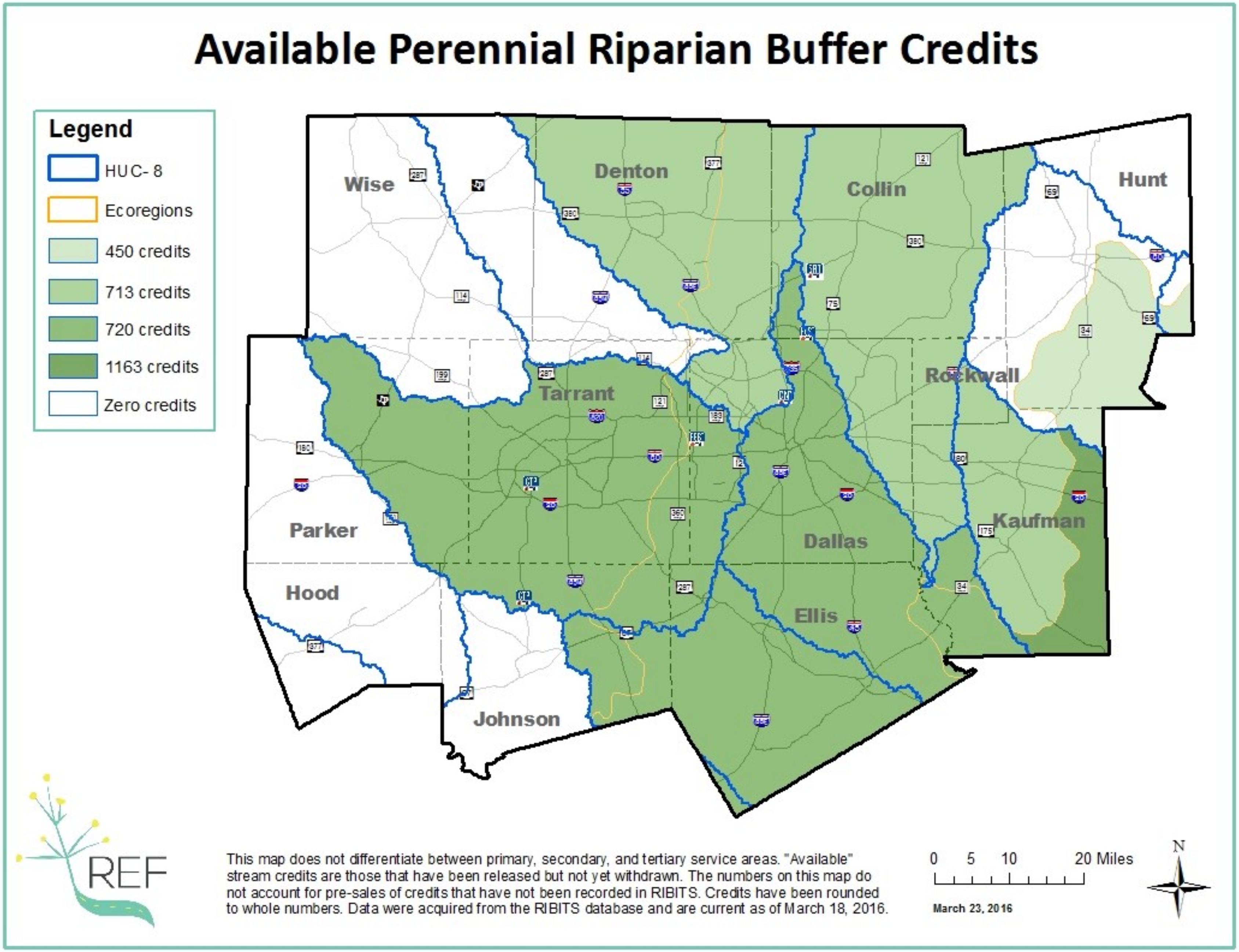


Figure A.18 Available stream mitigation credits, combined service areas, available perennial riparian buffer credits

Available Stream Mitigation Credits, Combined Service Areas

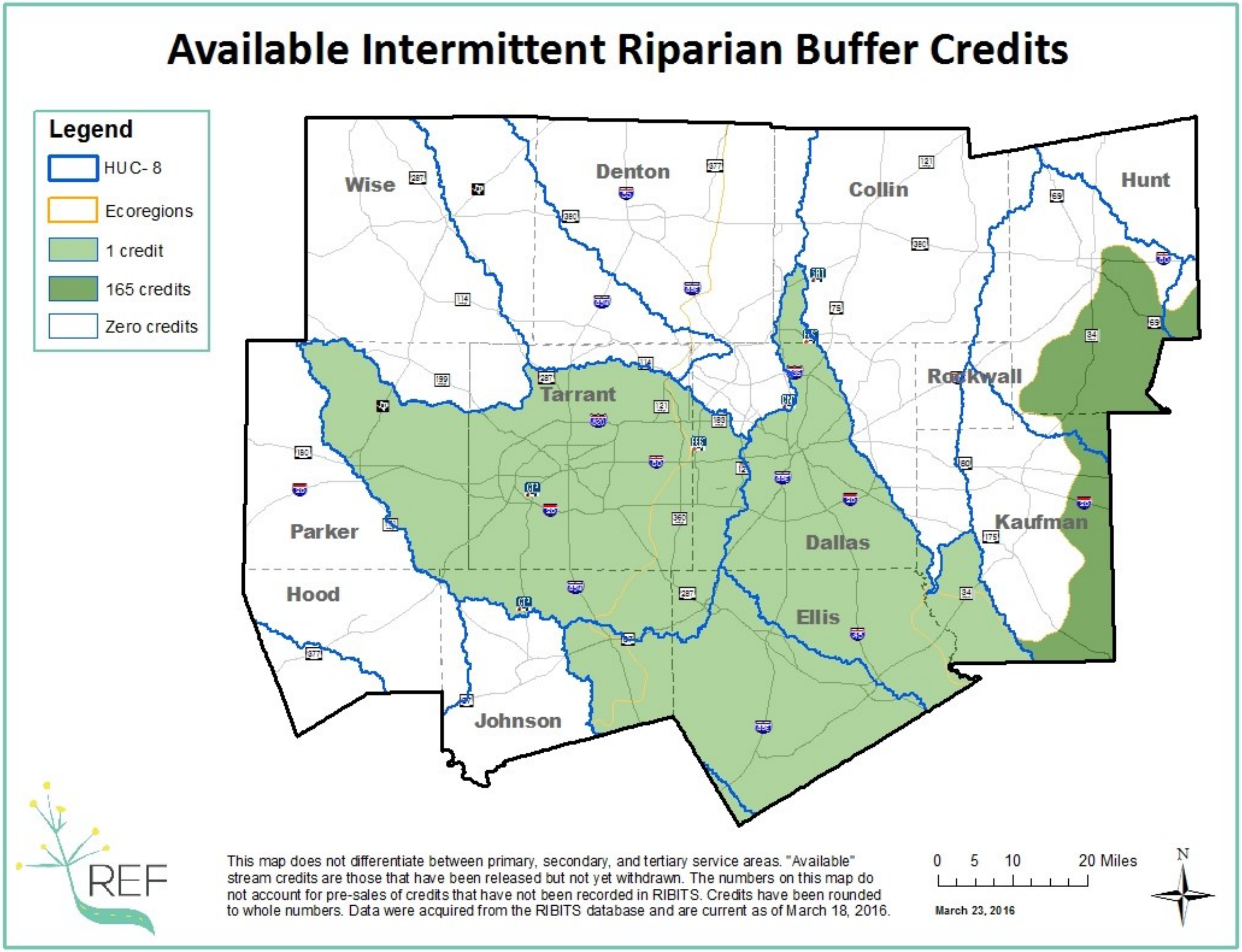


Figure A.19 Available stream mitigation credits, combined service areas, available intermittent riparian buffer credits

Available Stream Mitigation Credits, Combined Service Areas

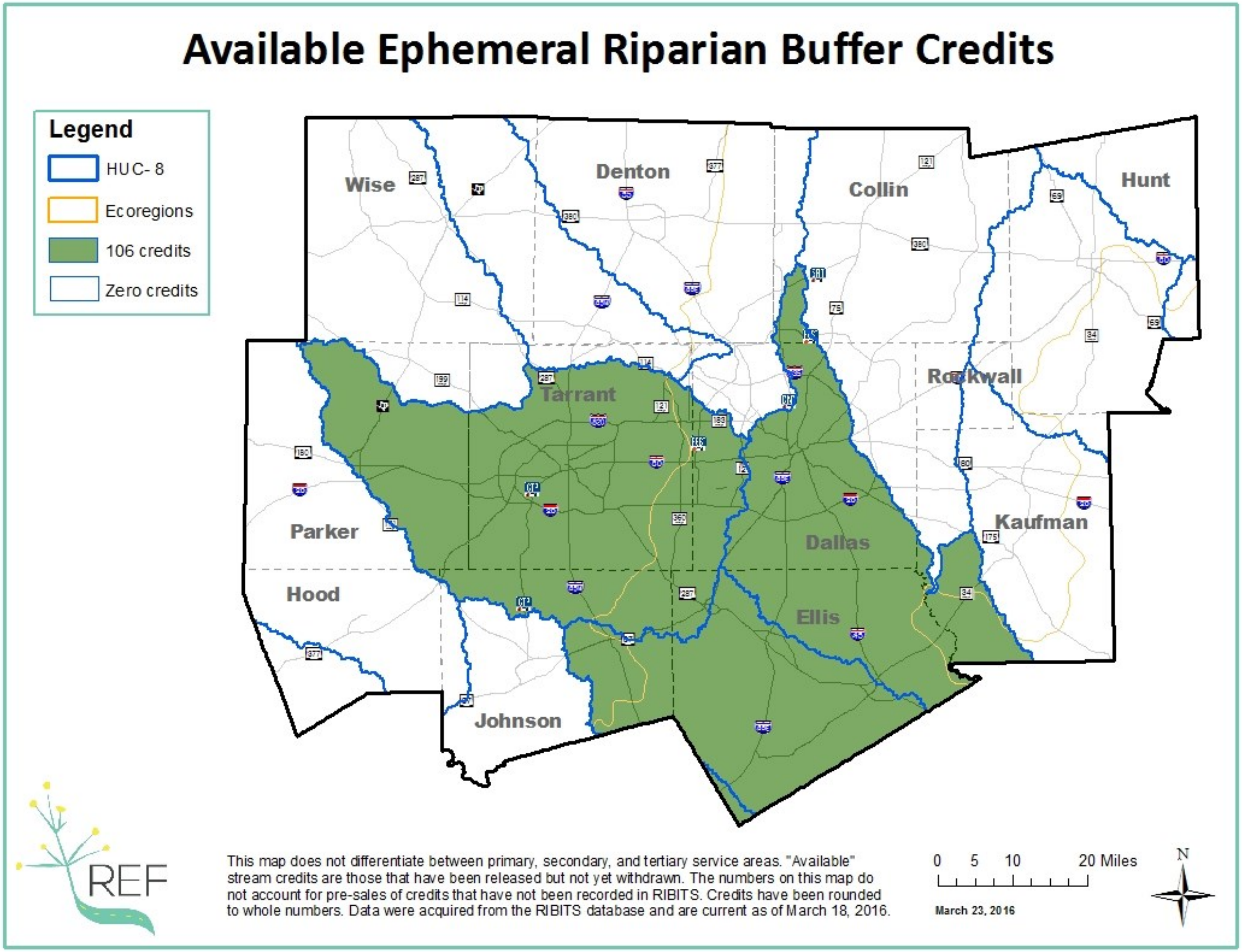


Figure A.20 Available stream mitigation credits, combined service areas, available ephemeral riparian credits

Available Stream Mitigation Credits, Combined Service Areas

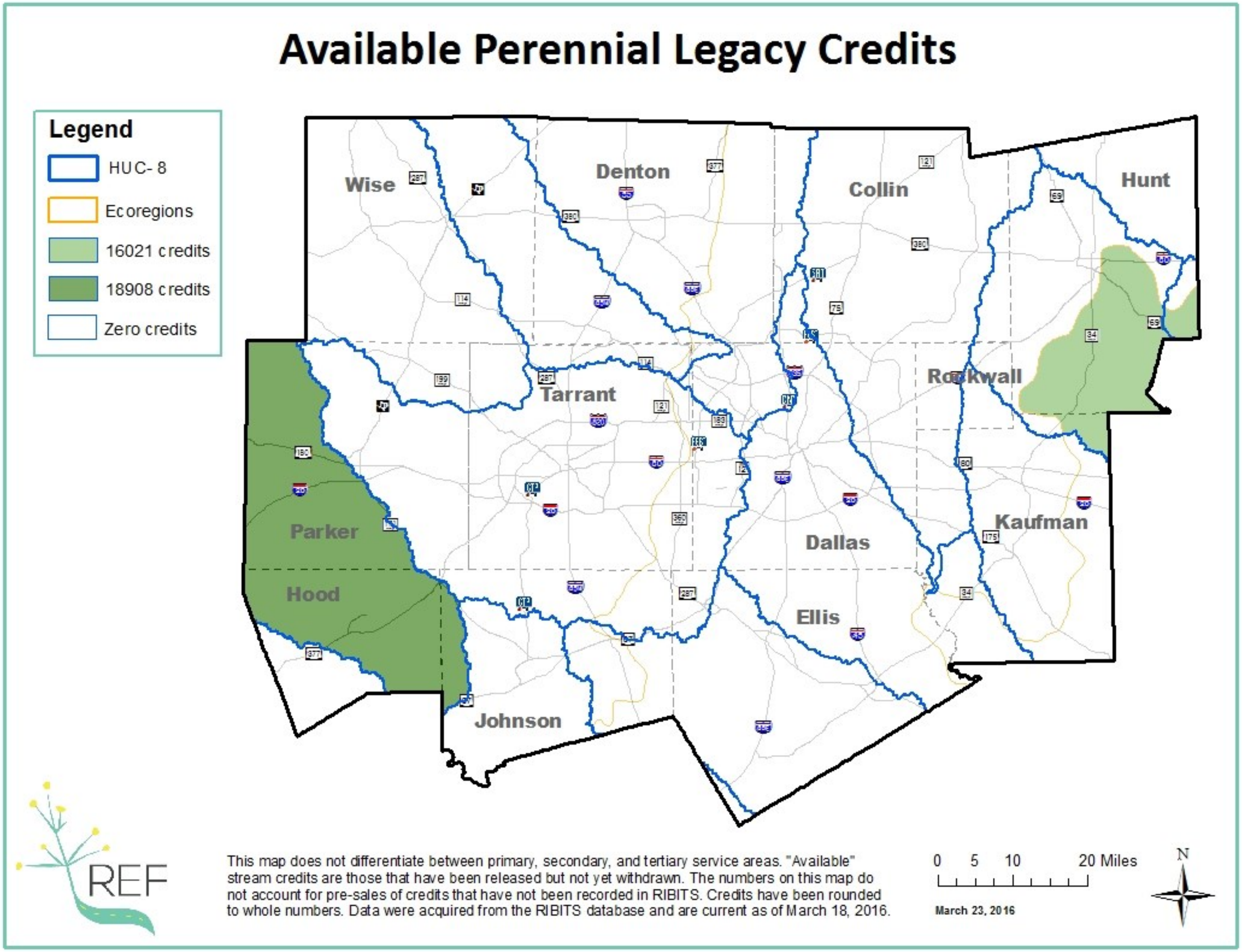


Figure A.21 Available stream mitigation credits, combined service areas, available perennial legacy credits

Available Stream Mitigation Credits, Combined Service Areas

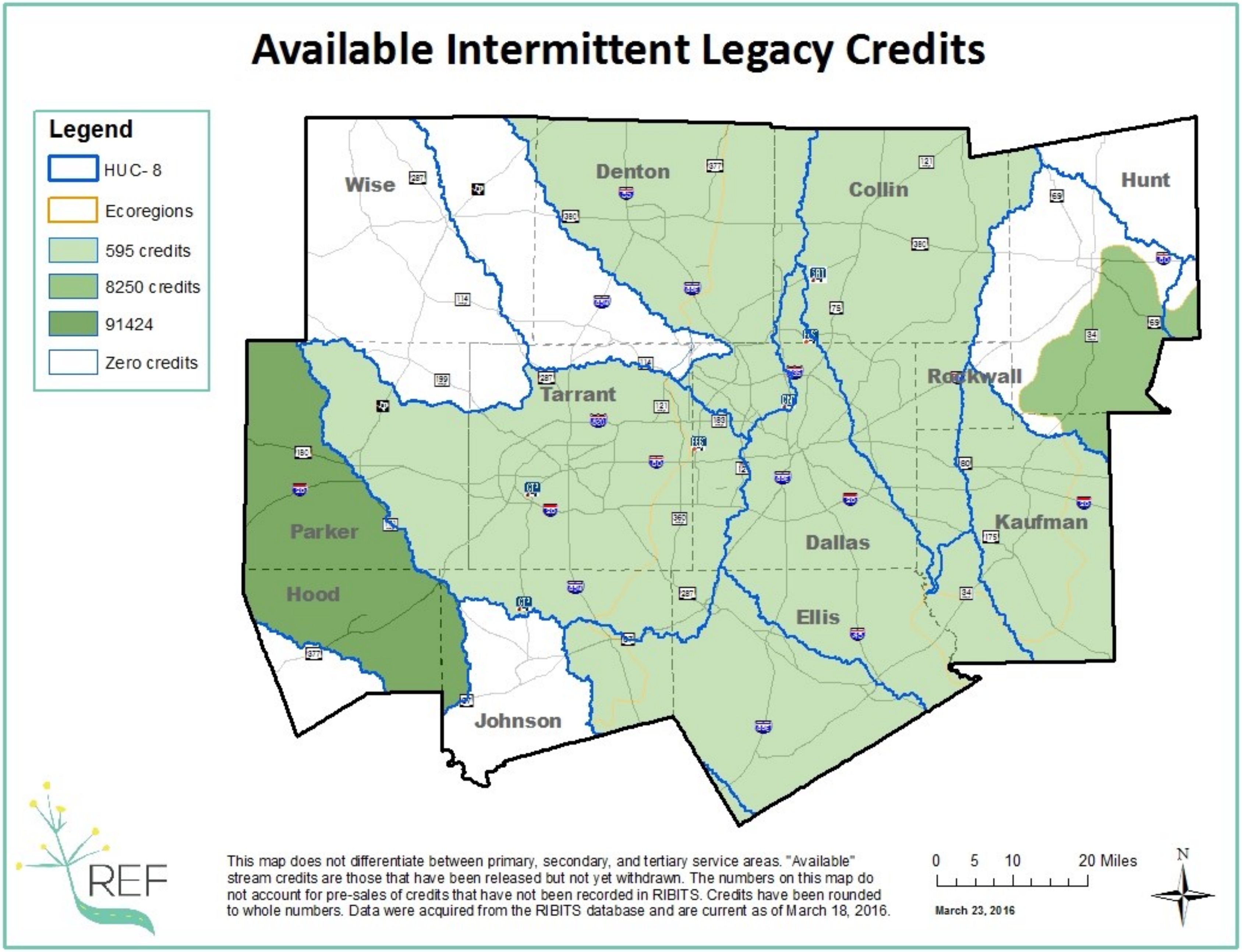


Figure A.22 Available stream mitigation credits, combined service areas, available intermittent legacy credits

Available Stream Mitigation Credits, Combined Service Areas

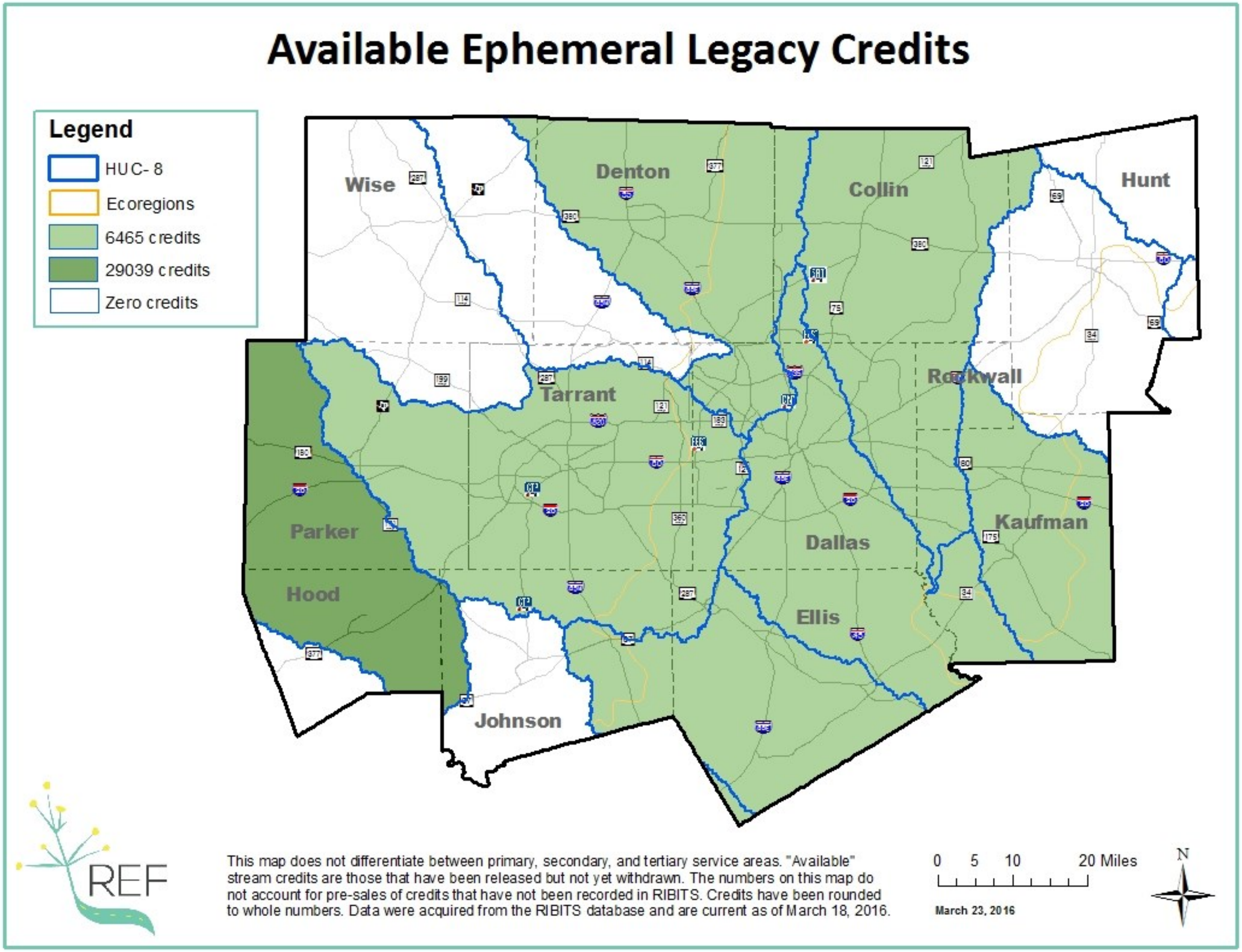


Figure A.23 Available stream mitigation credits, combined service areas, available ephemeral legacy credits

Available Stream Mitigation Credits, Combined Service Areas

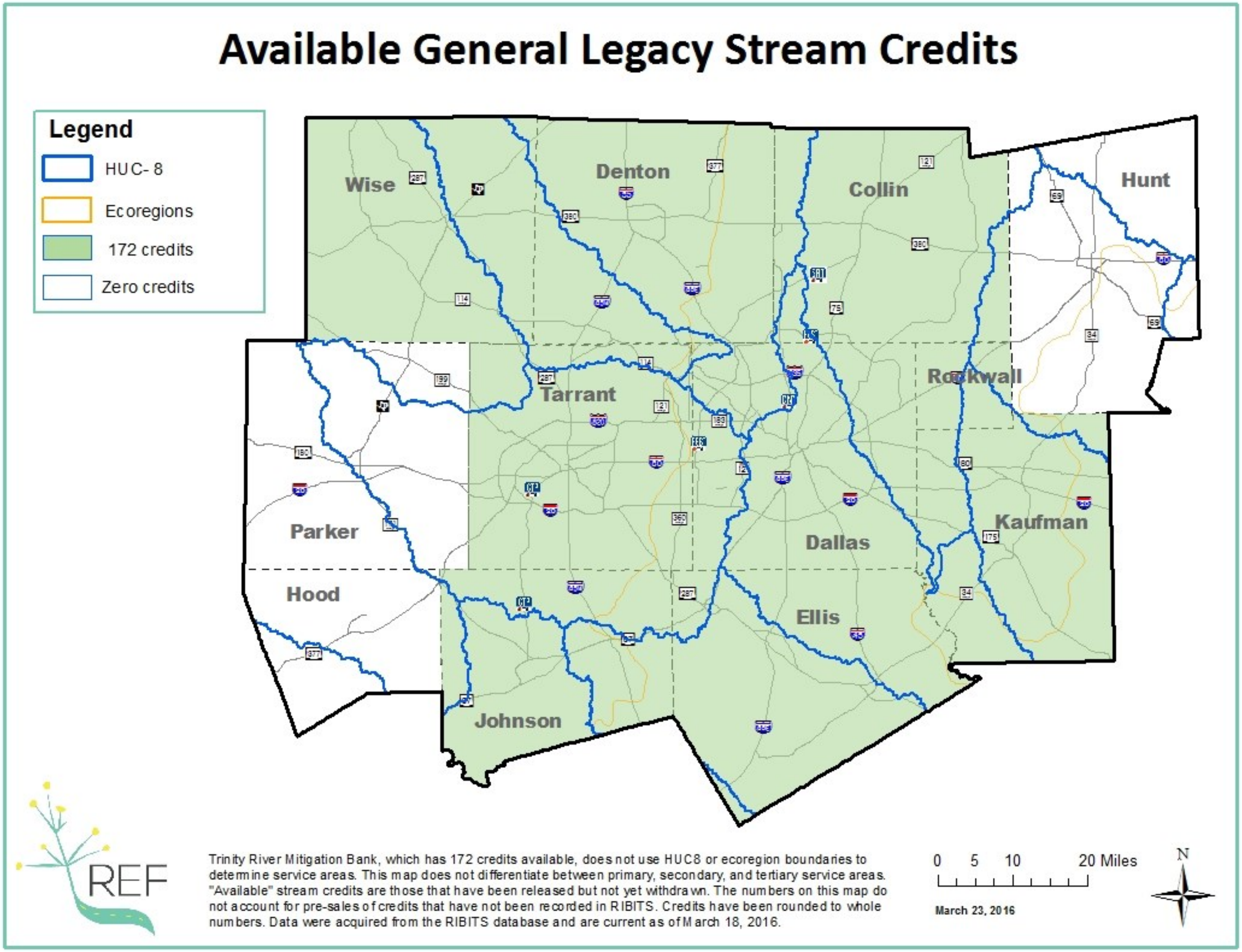


Figure A.24 Available stream mitigation credits, combined service areas, available general legacy stream credits

Available Stream Mitigation Credits, Combined Service Areas

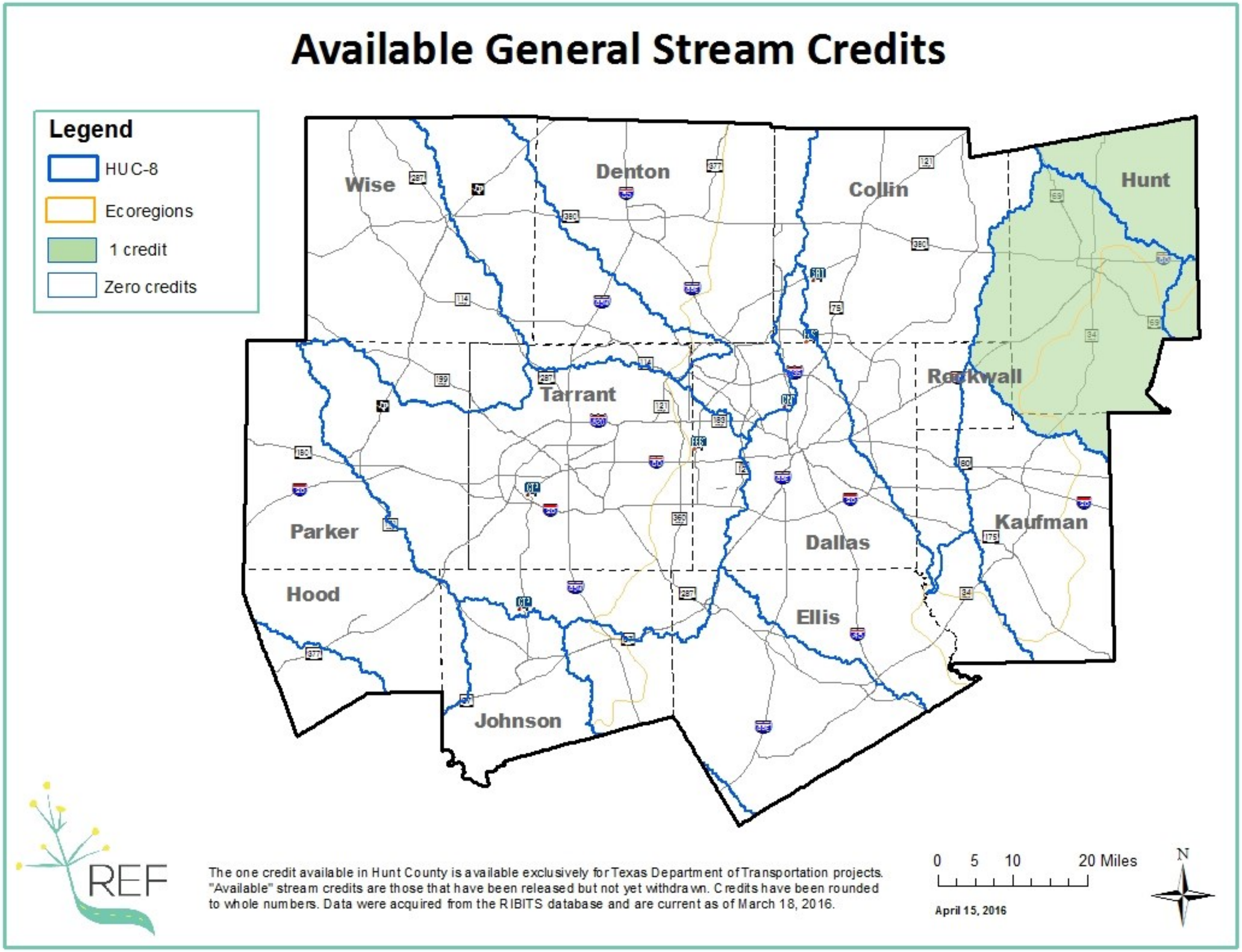


Figure A.25 Available stream mitigation credits, combined service areas, available general stream credits

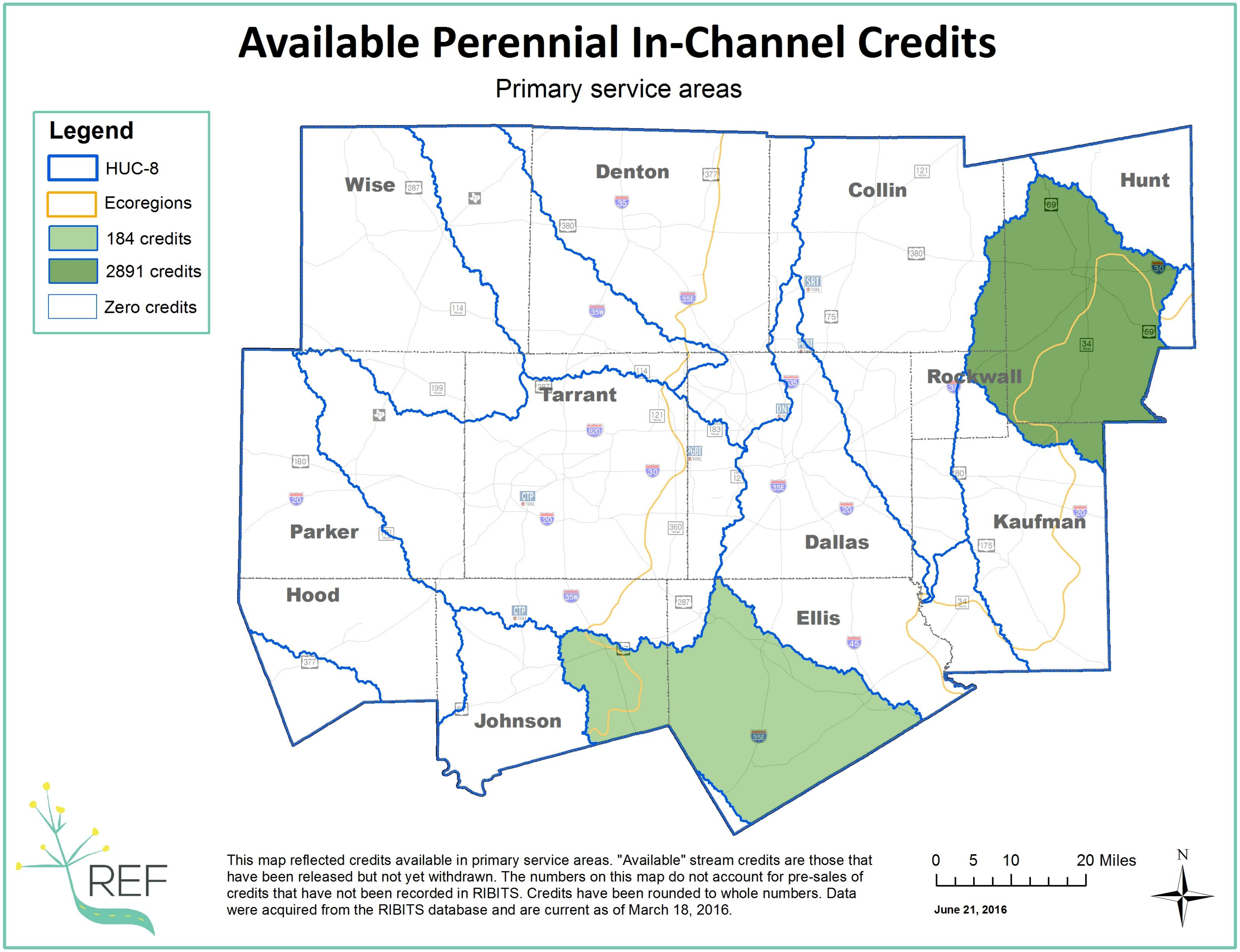


Figure A.26 Available stream mitigation credits, primary service area, available perennial in-channel credits

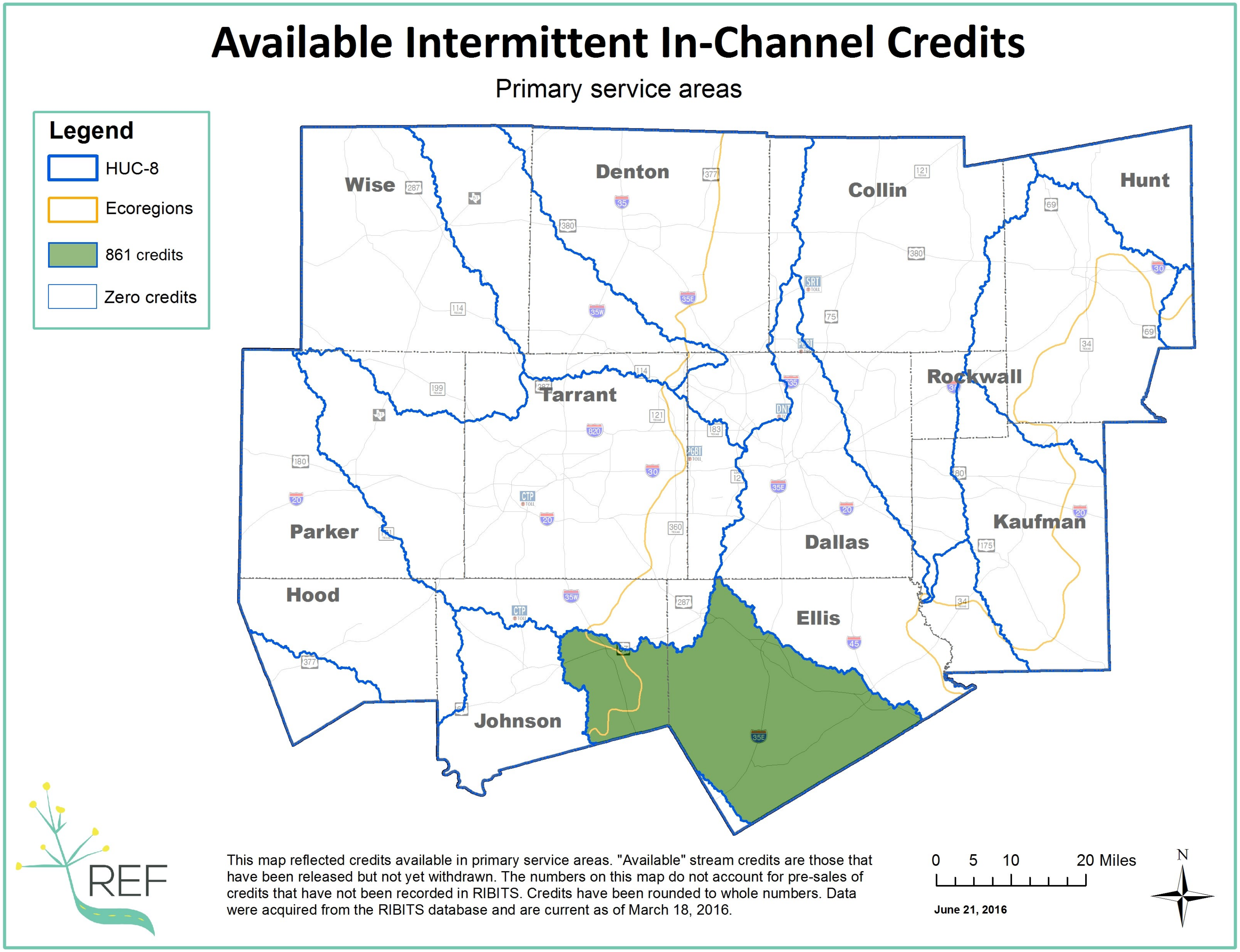


Figure A.27 Available stream mitigation credits, primary service area, available intermittent in-channel credits

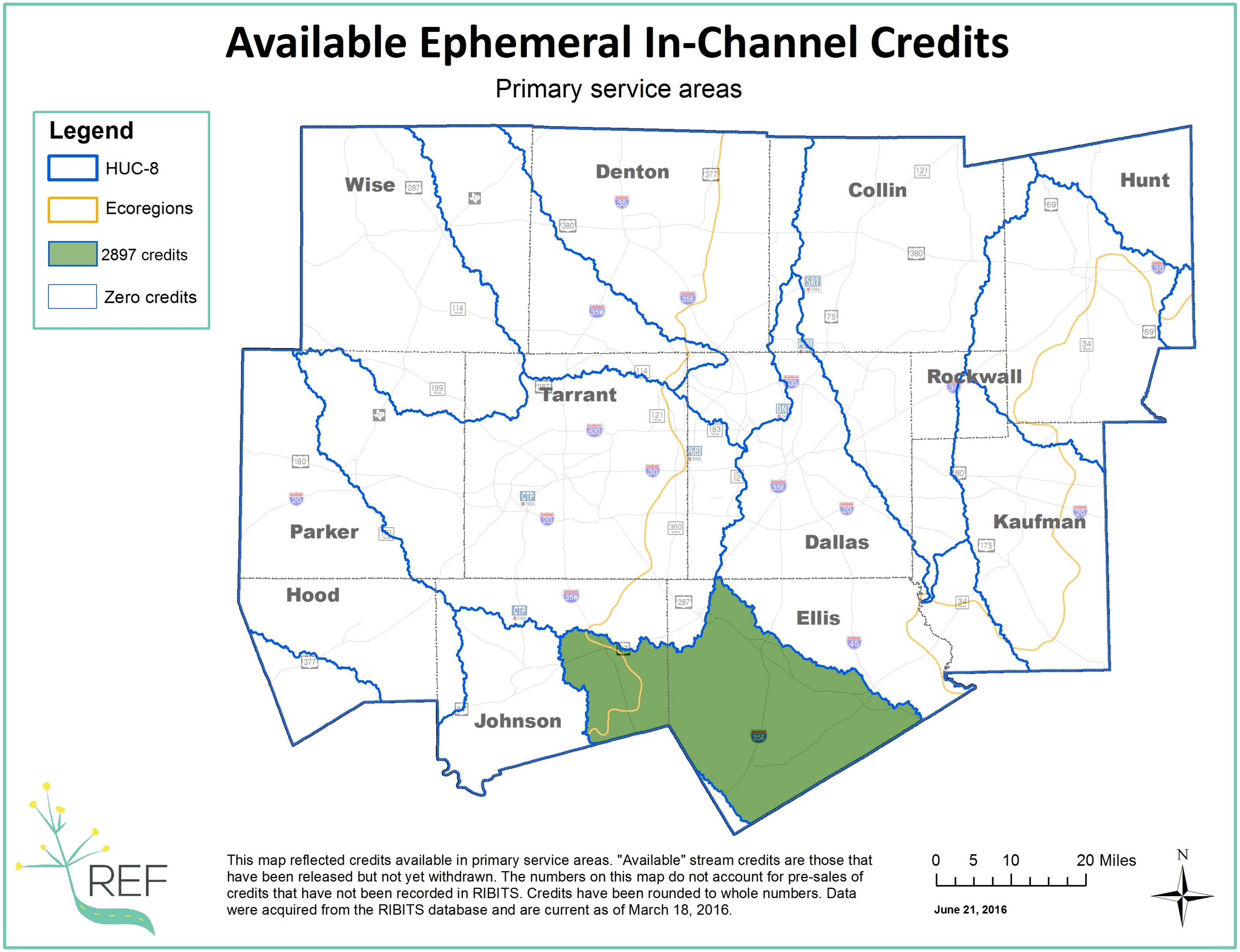


Figure A.28 Available stream mitigation credits, primary service area, available ephemeral in-channel credits

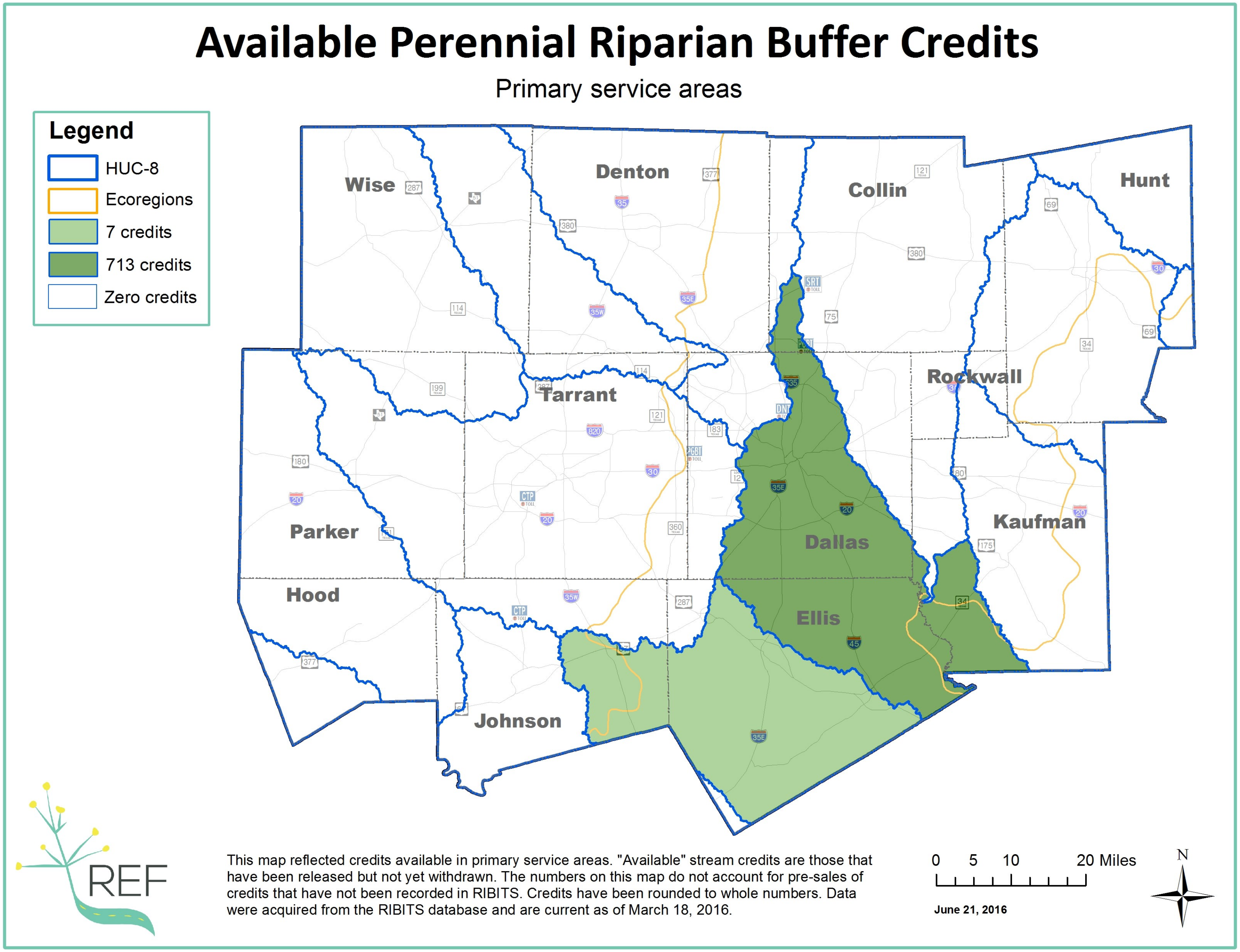


Figure A.29 Available stream mitigation credits, primary service area, available perennial riparian buffer credits

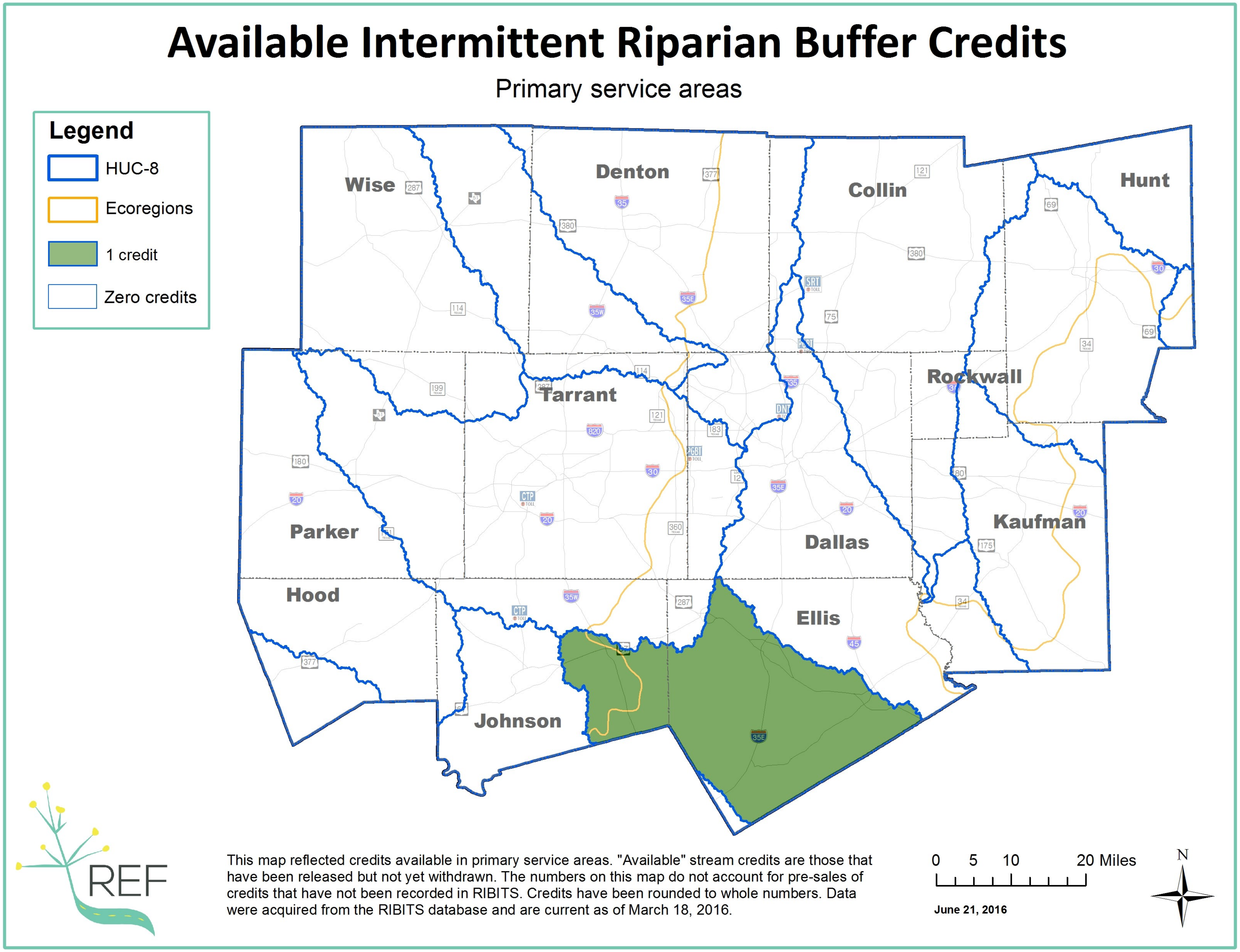


Figure A.30 Available stream mitigation credits, primary service area, available intermittent riparian buffer credits

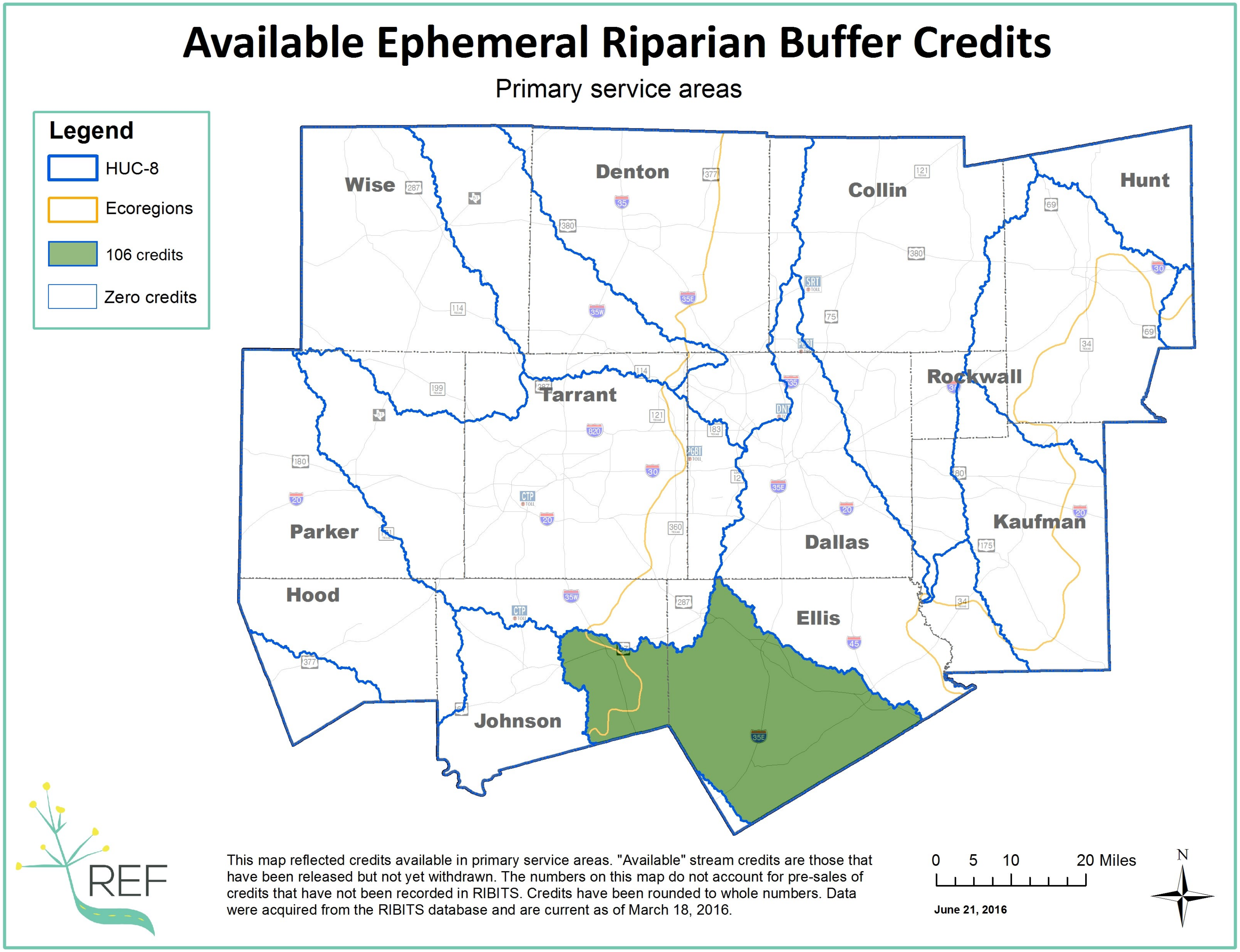


Figure A.31 Available stream mitigation credits, primary service area, available ephemeral riparian buffer credits

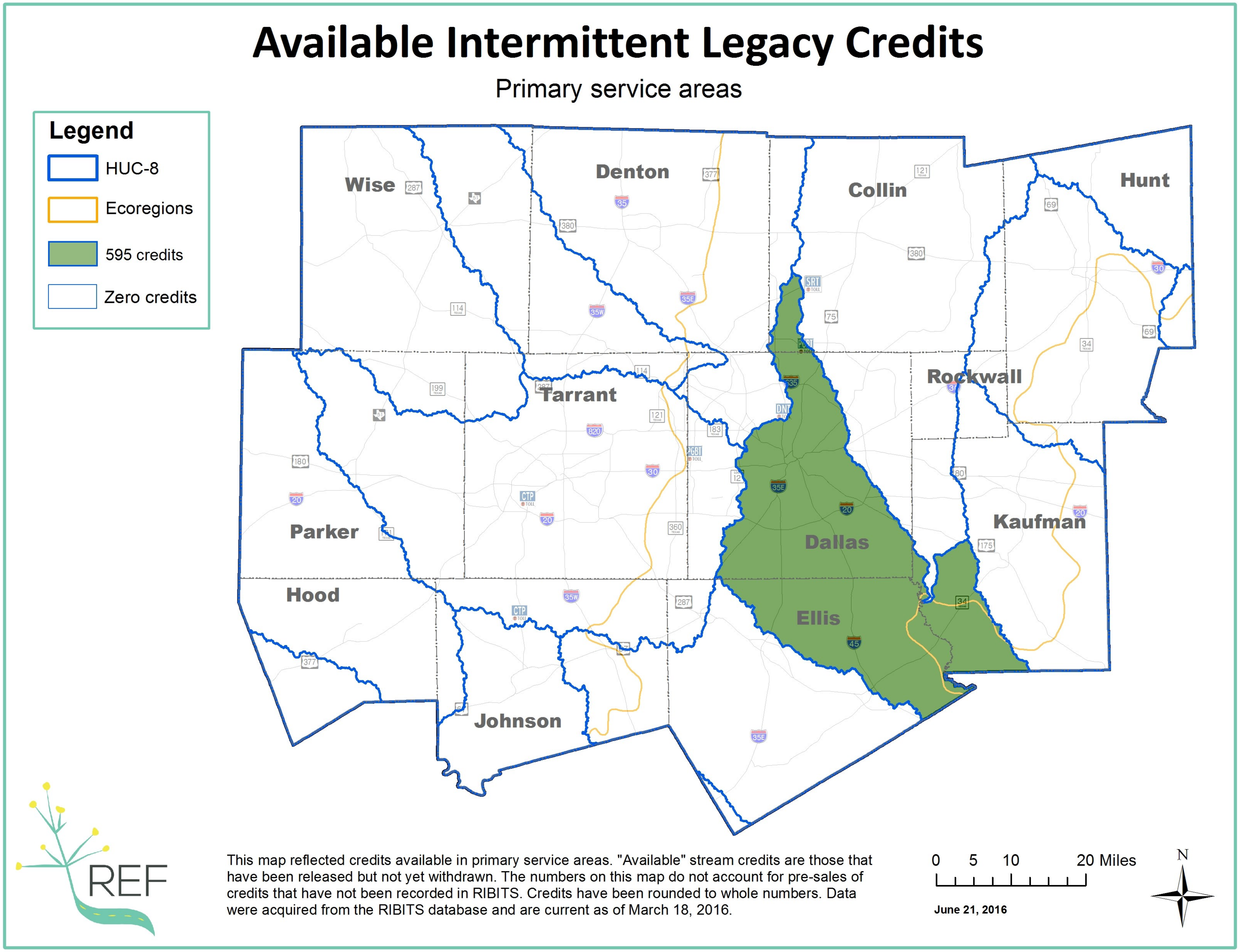


Figure A.32 Available stream mitigation credits, primary service area, available intermittent legacy credits

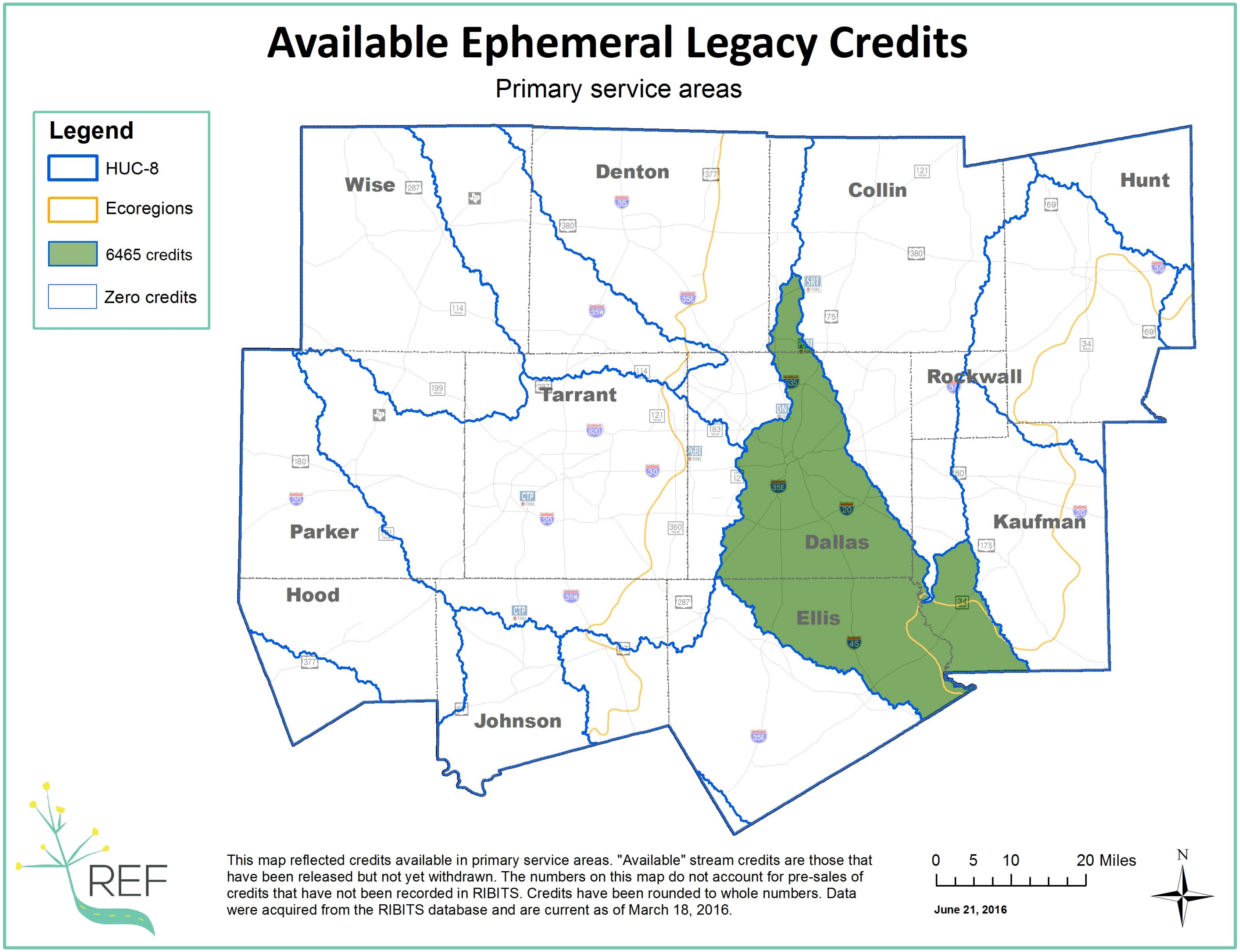


Figure A.33 Available stream mitigation credits, primary service area, available ephemeral legacy credits

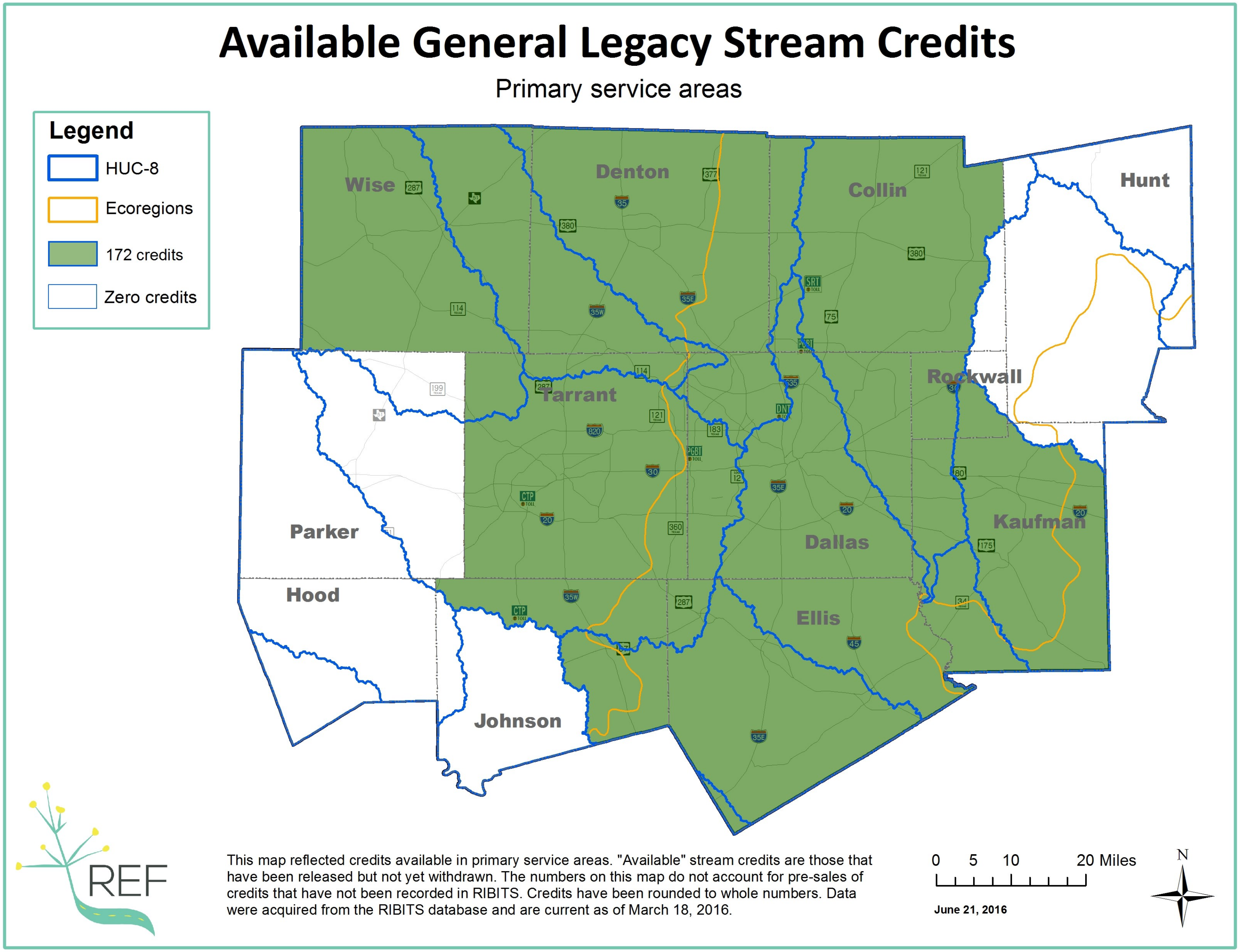


Figure A.34 Available stream mitigation credits, primary service area, available general legacy stream credits

Available Stream Mitigation Credits, Primary Service Areas

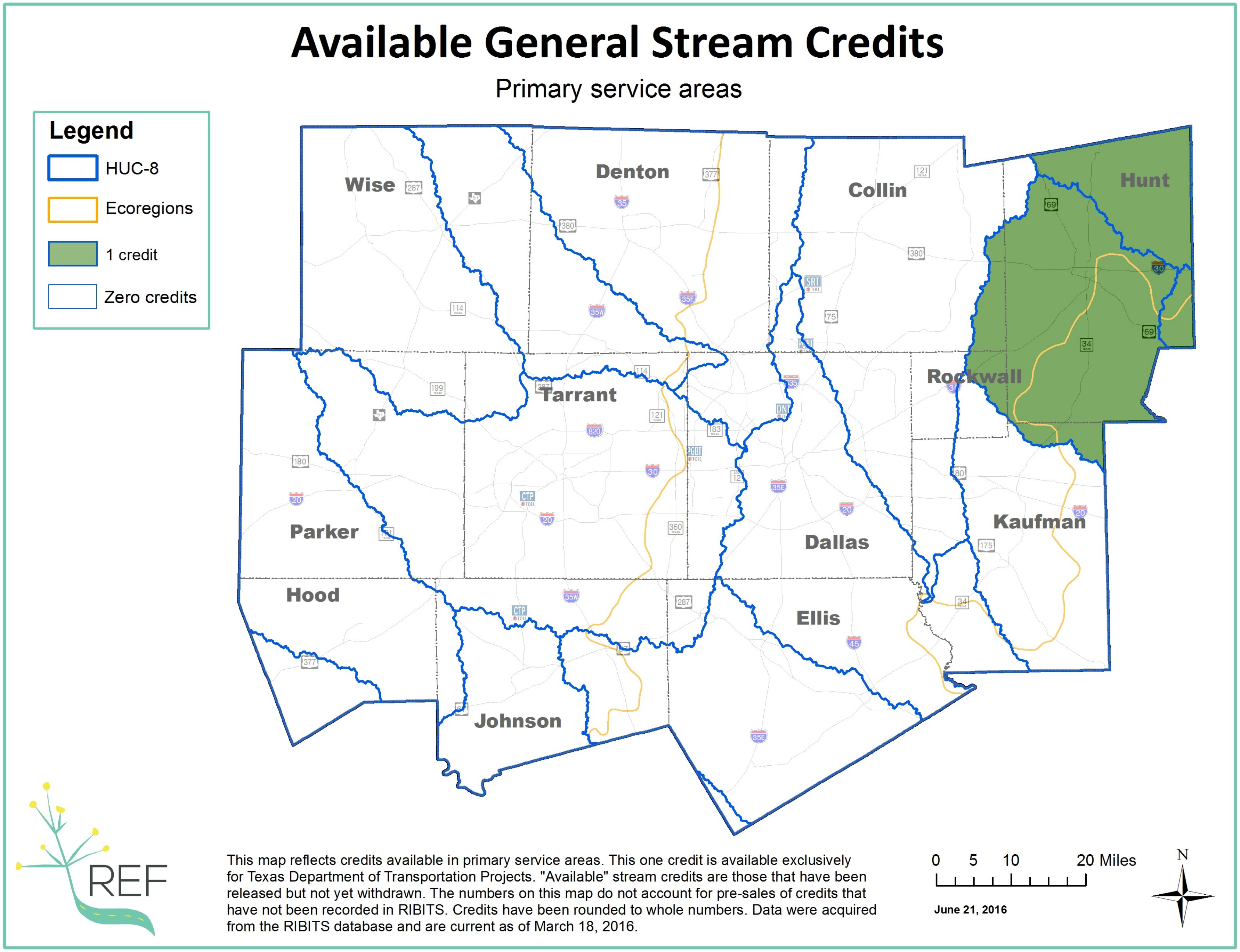


Figure A.35 Available stream mitigation credits, primary service area, available general stream credits

Discussion of Potential but Unreleased Credits

Wetlands

Hood County and portions of Parker and Johnson counties have zero credits in any service area. The remaining portions of the region have more than 900 credits available in any service area. Wise County and portions of Denton, Parker, Tarrant, Johnson, and Kaufman counties have fewer than 50 credits in primary service areas. The majority of the eastern portion of the region has more than 150 credits in primary service areas.

Perennial Streams

In-channel credits: Northern, southwestern, and some eastern portions of the region have no credits in any service area. Ellis and portions of Parker, Tarrant, Johnson, Dallas, Collin, and Kaufman counties have 736 credits in any service area. Much of Hunt County and portions of Collin, Rockwall, and Kaufman counties have more than 9,500 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Johnson and Ellis counties have 736 credits and portions of eastern counties have more than 9,500 credits in primary service areas.

Riparian buffer credits: Portions of western and northeastern counties have zero credits in any service area. Dallas and Ellis counties and portions of central and eastern counties have 1,324 to 3,875 credits in any service area. The majority of the region has zero to 42 credits in primary service areas. Portions of Collin, Dallas, Ellis, and Kaufman counties have 1,324 credit in primary service areas.

Legacy stream credits: Much of the region has zero credits in any service area. Portions of Parker, Hood, and Johnson counties have more than 2,800 credits in any service area. Zero credits exist in primary service areas in the region.

Intermittent Streams

In-channel credits: Portions of western and eastern counties have zero credits in any service area. Ellis and Dallas counties and portions of the region's central counties have from 1,085 to 11,299 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Denton, Collin, Dallas, Ellis, and Johnson counties have 1,085 ore more credits in primary service areas.

Riparian buffer credits: Portions of western and eastern counties have zero credits in any service area. Dallas and Ellis counties and portions of central and eastern counties have 935 to 4,995 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Johnson, Ellis, Denton, Collin, and Dallas counties have 1,343 or more credits in primary service areas.

Legacy stream credits: Much of Wise and Hunt counties and portions of counties in the north, southwest, and northeast sections of the region have zero credits in any service area. Portions of counties in the southwest and central sections of the region have 1,364 to 143,394 credits. The majority of the region has zero credits in primary service areas. Portions of Collin, Dallas, Ellis, and Kaufman counties have 1,364 credits in primary service areas.

Ephemeral Streams

In-channel credits: Portions of western and eastern counties have zero credits in any service area. Ellis and Dallas counties and portions of the region's central counties have from 2,623 to 11,571 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Denton, Collin, Dallas, Ellis, and Johnson counties have 2,623 to 8,949 credits in primary service areas.

Riparian buffer credits: Portions of western and eastern counties have zero credits in any service area. Dallas and Ellis counties and the central section of the region have 877 to 3,210 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Denton, Collin, and Dallas counties have 877 credits and portions of Ellis and Johnson counties have 2,333 credits in primary service areas.

Legacy stream credits: Portions of northwestern, southwestern, and northeastern counties have zero credits in any service area. Central and southern portions of the region have 13,697 to 45,500 credits in any service area. The majority of the region has zero credits in primary service areas. Portions of Collin, Dallas, Ellis, and Kaufman counties have 13,697 credits in primary service areas.

Other

General legacy stream credits: Hunt, Parker, and Hood counties have zero credits in any service area. The region's other counties have 127 credits in any service area. Hunt, Parker, and Hood counties, and portions of Collin, Rockwall, Kaufman, and Johnson counties, have zero credits in primary service areas. The rest of the region has 127 credits available in primary service areas.

Potential Wetland Mitigation Credits, Combined Service Areas

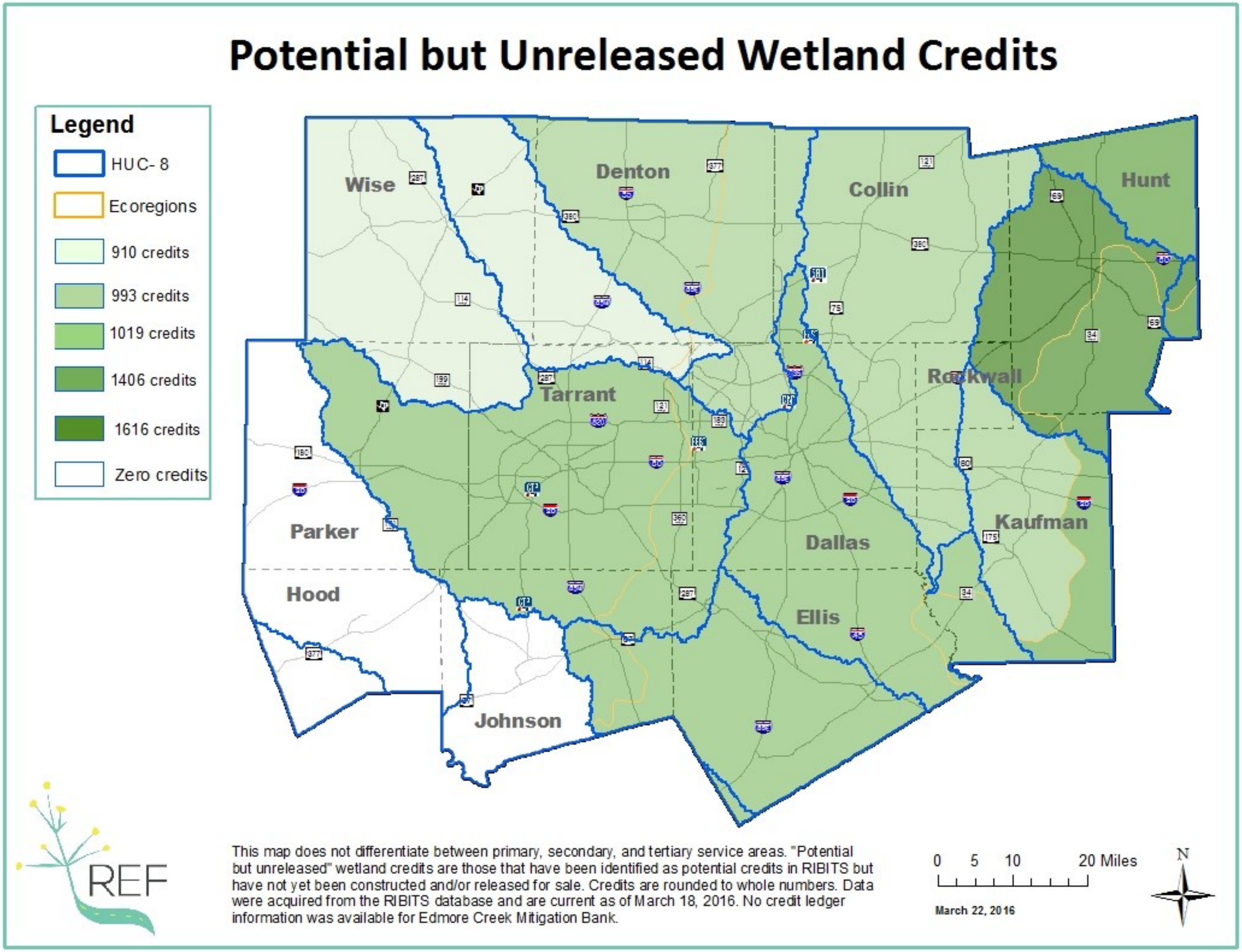


Figure A.36 Potential wetland mitigation credits, combined service areas, potential but unreleased wetland credits

Potential Stream Mitigation Credits, Combined Service Areas

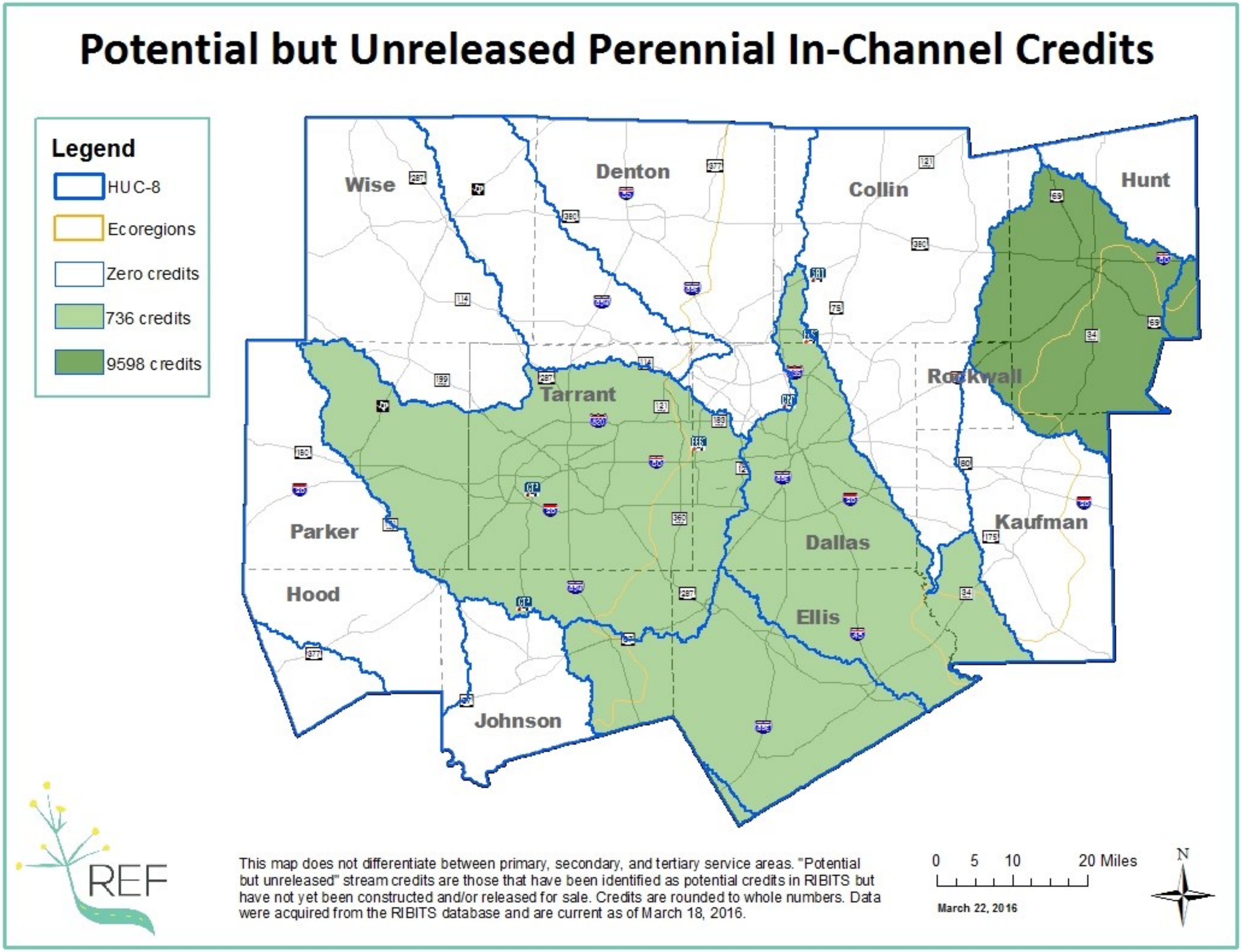


Figure A.37 Potential stream mitigation credits, combined service areas, potential but unreleased perennial in-channel credits

Potential Stream Mitigation Credits, Combined Service Areas

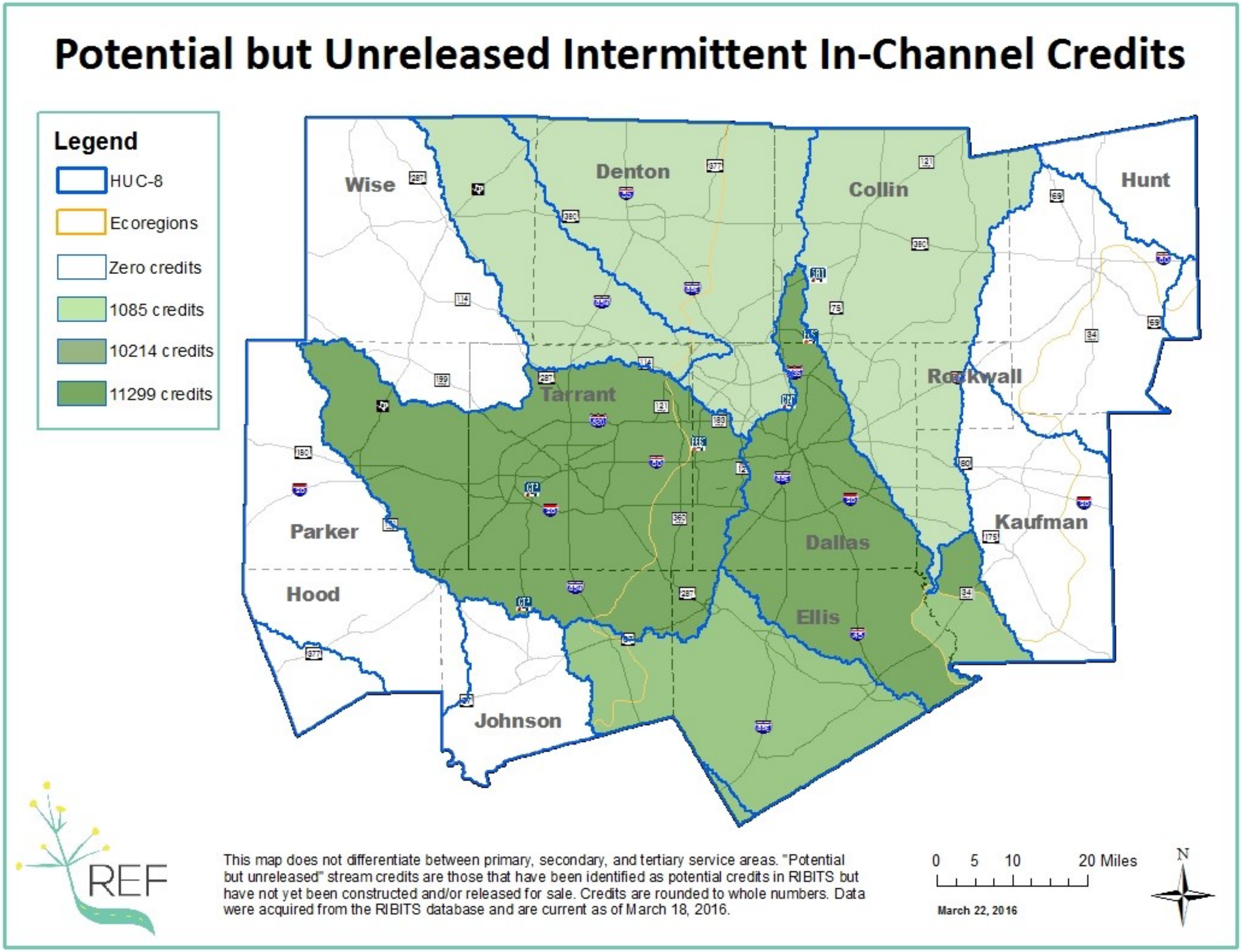


Figure A.38 Potential stream mitigation credits, combined service areas, potential but unreleased intermittent in-channel credits

Potential Stream Mitigation Credits, Combined Service Areas

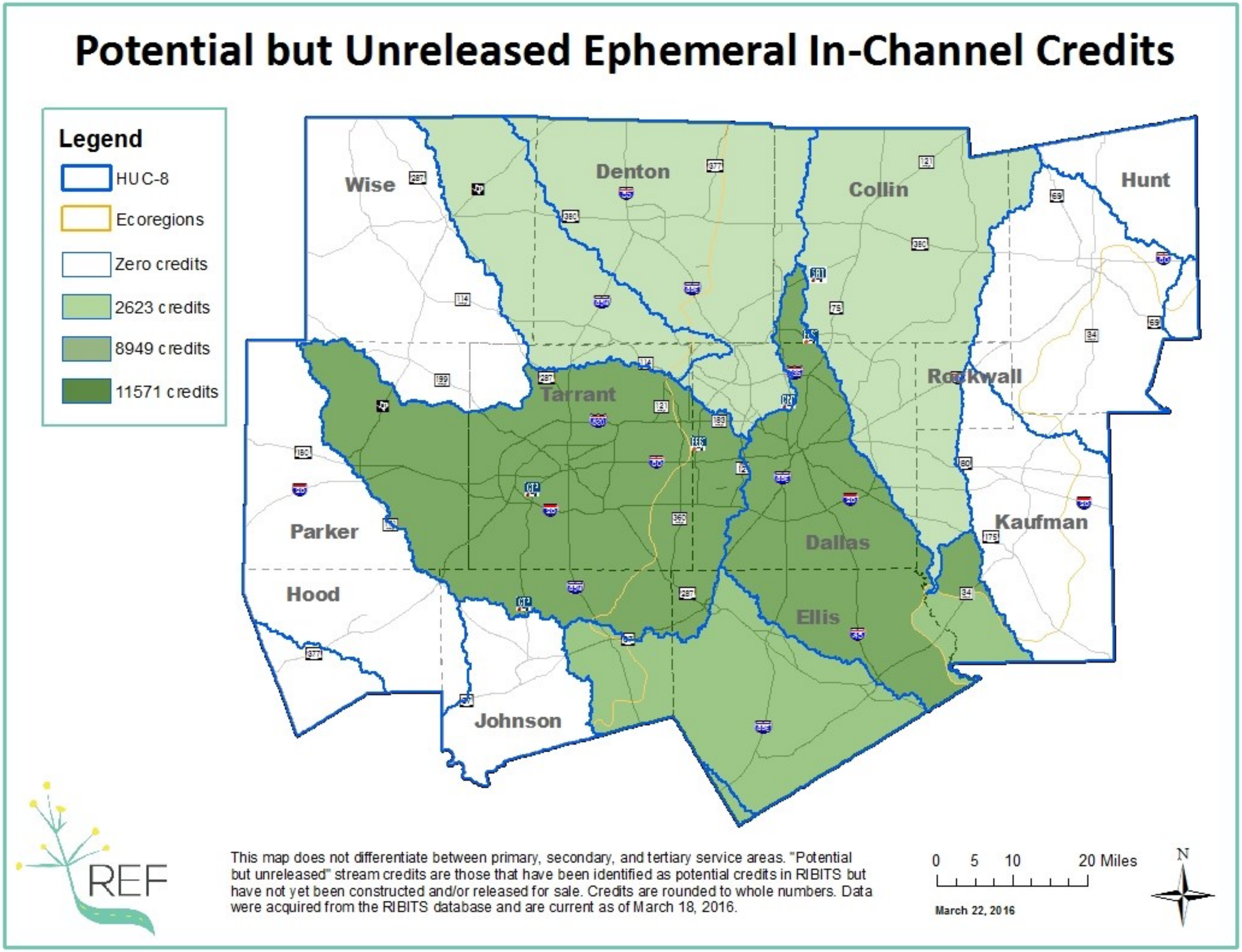


Figure A.39 Potential stream mitigation credits, combined service areas, potential but unreleased ephemeral in-channel credits

Potential Stream Mitigation Credits, Combined Service Areas

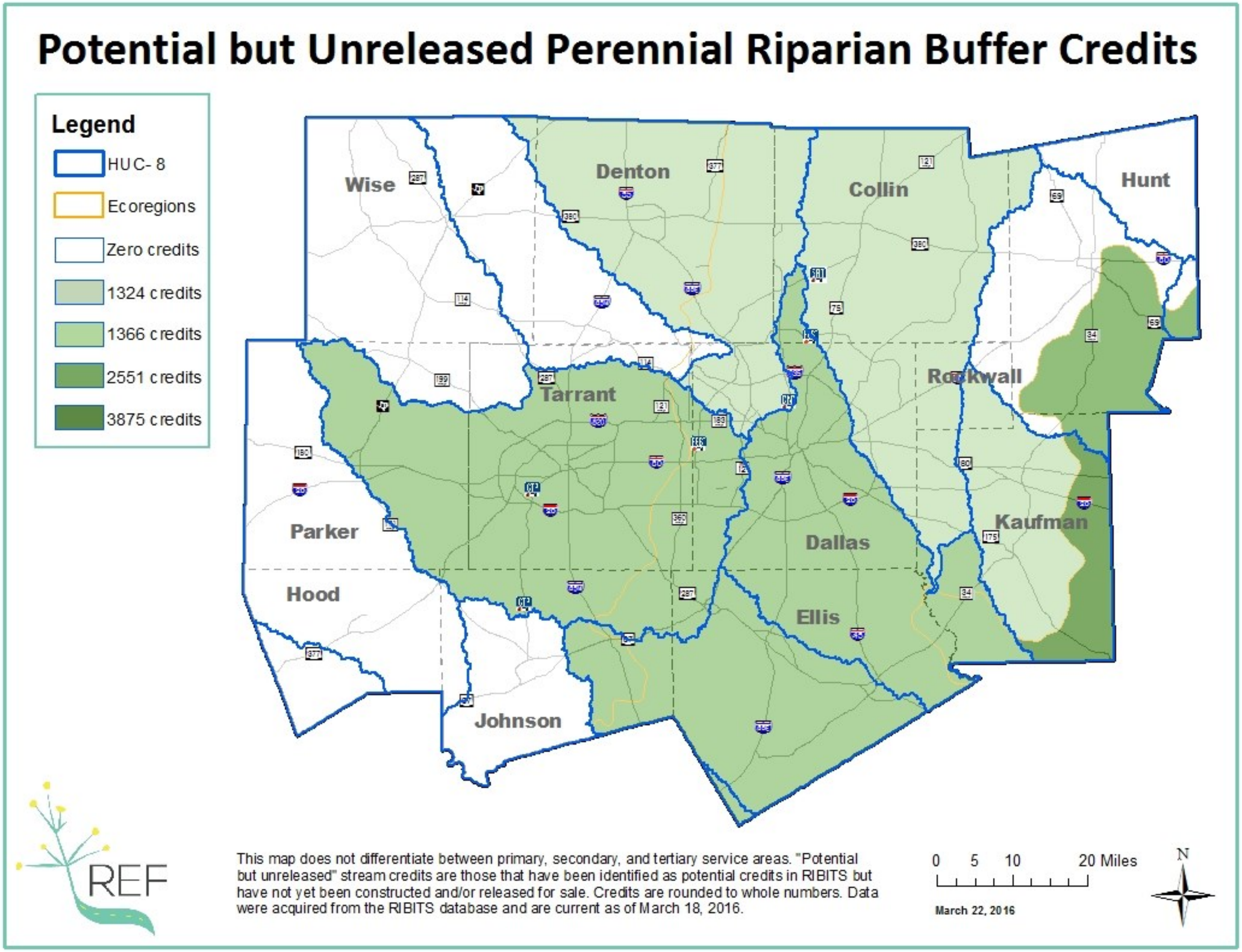


Figure A.40 Potential stream mitigation credits, combined service areas, potential but unreleased perennial riparian buffer credits

Potential Stream Mitigation Credits, Combined Service Areas

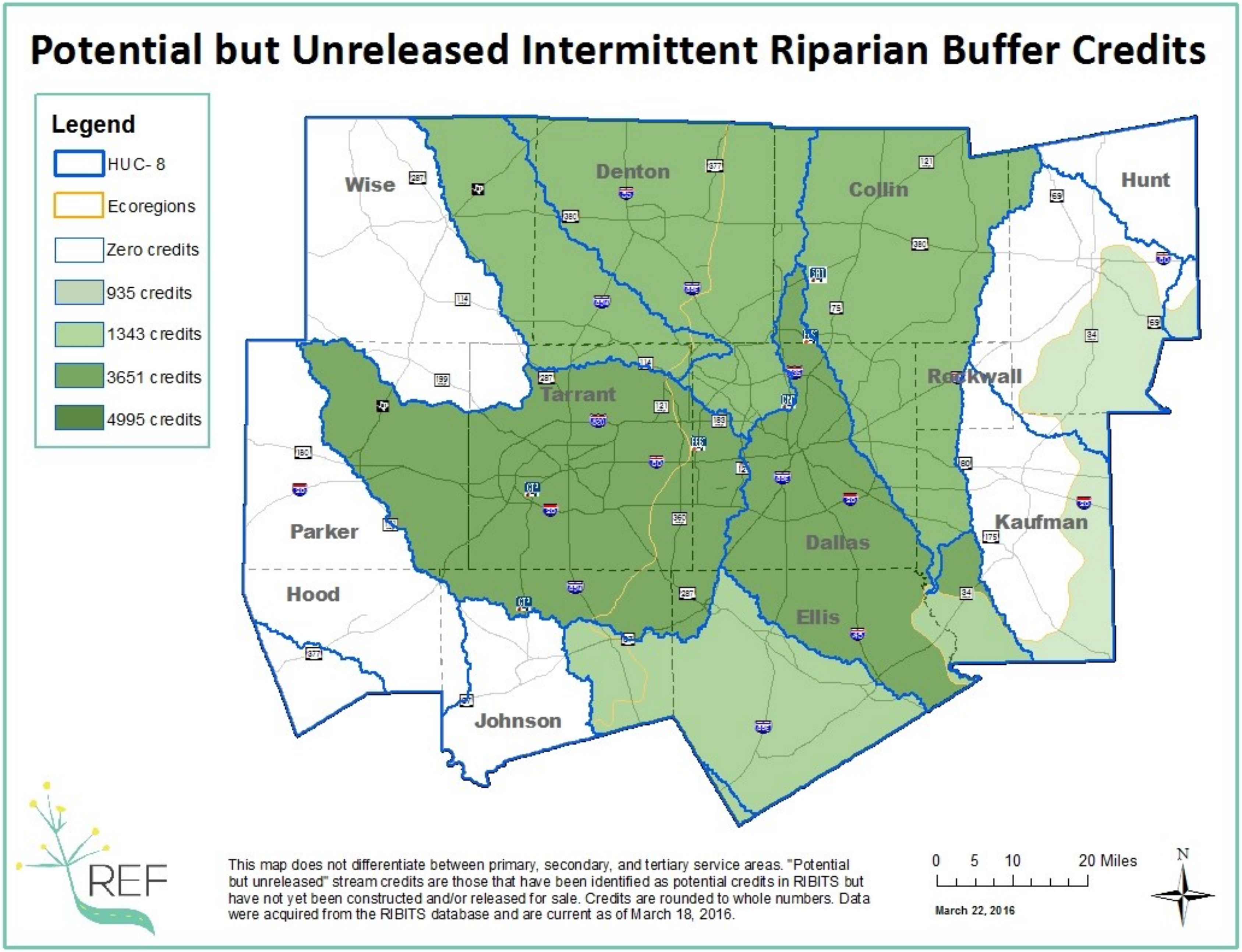


Figure A.41 Potential stream mitigation credits, combined service areas, potential but unreleased intermittent riparian buffer credits

Potential Stream Mitigation Credits, Combined Service Areas

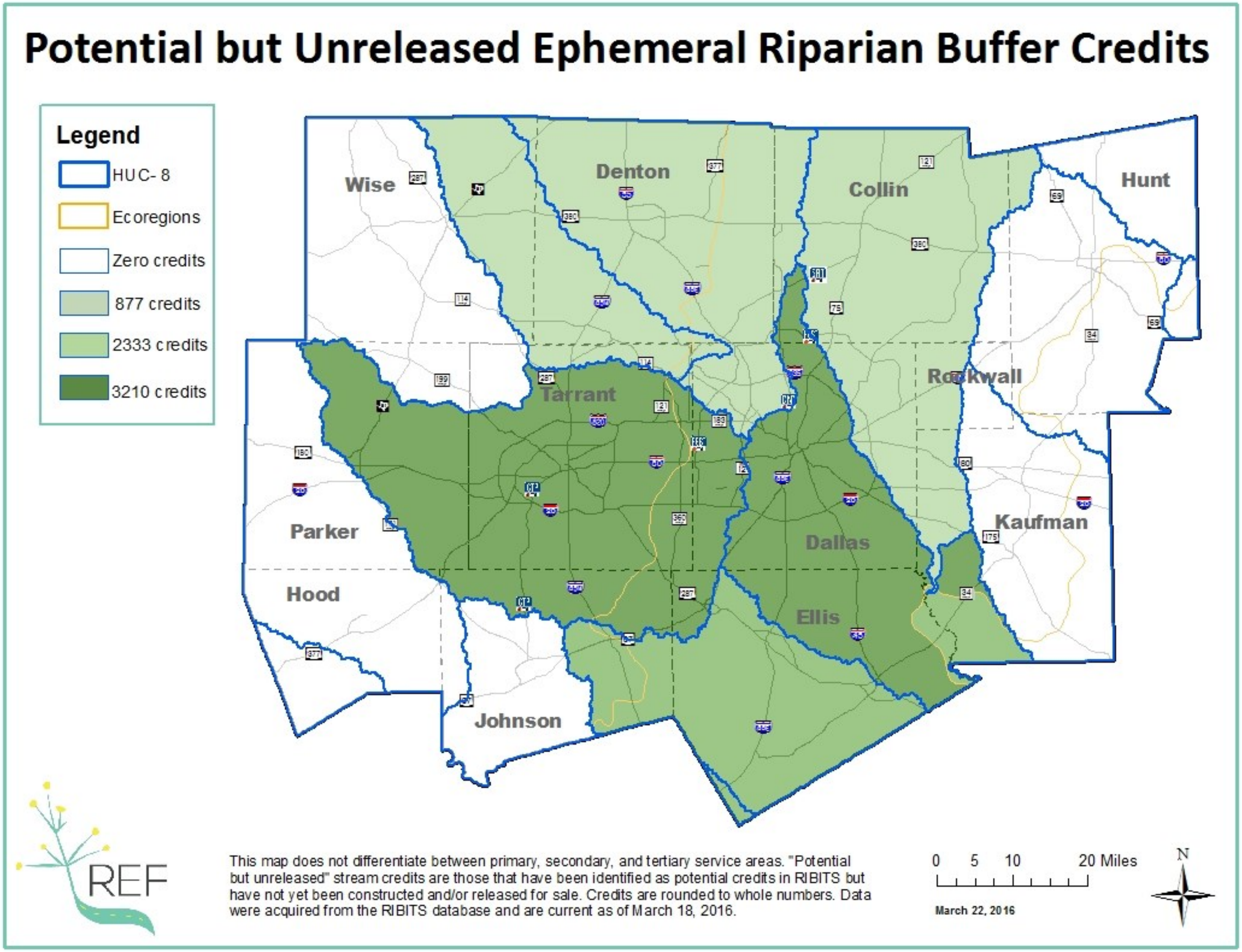


Figure A.42 Potential stream mitigation credits, combined service areas, potential but unreleased ephemeral riparian buffer credits

Potential Stream Mitigation Credits, Combined Service Areas

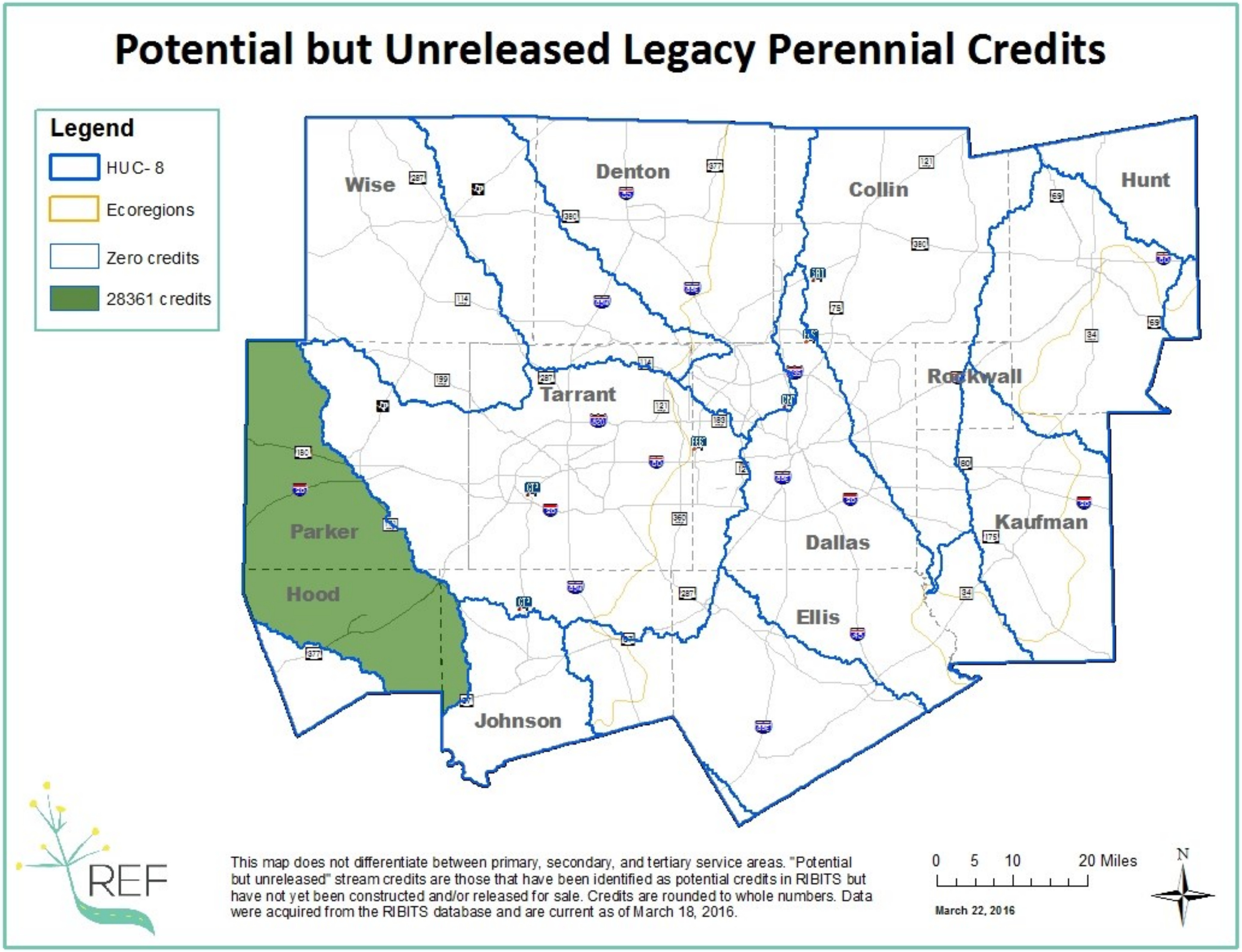


Figure A.43 Potential stream mitigation credits, combined service areas, potential but unreleased legacy perennial credits

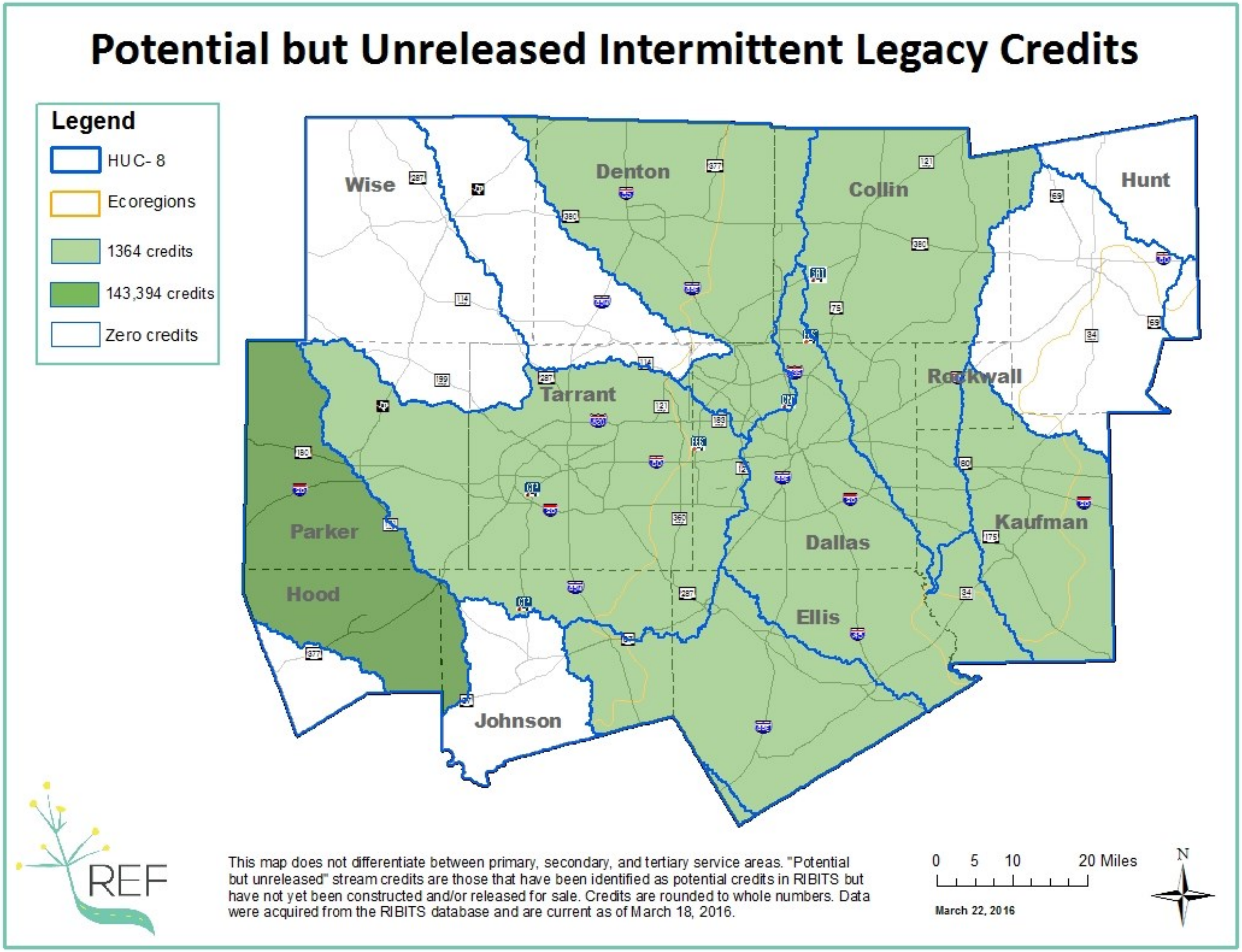


Figure A.44 Potential stream mitigation credits, combined service areas, potential but unreleased intermittent legacy credits

Potential Stream Mitigation Credits, Combined Service Areas

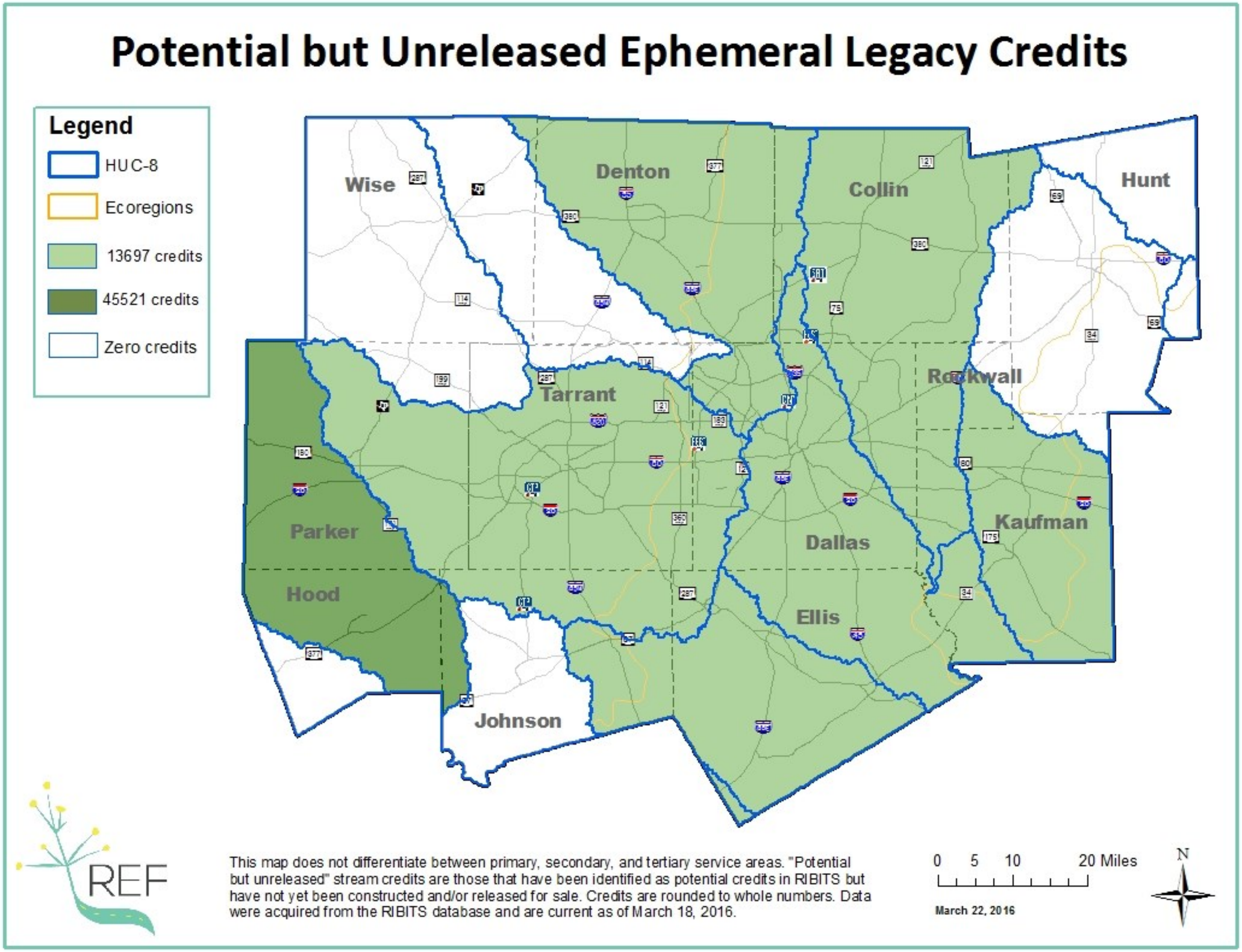


Figure A.45 Potential stream mitigation credits, combined service areas, potential but unreleased ephemeral legacy credits

Potential Stream Mitigation Credits, Combined Service Areas, Trinity River Mitigation Bank

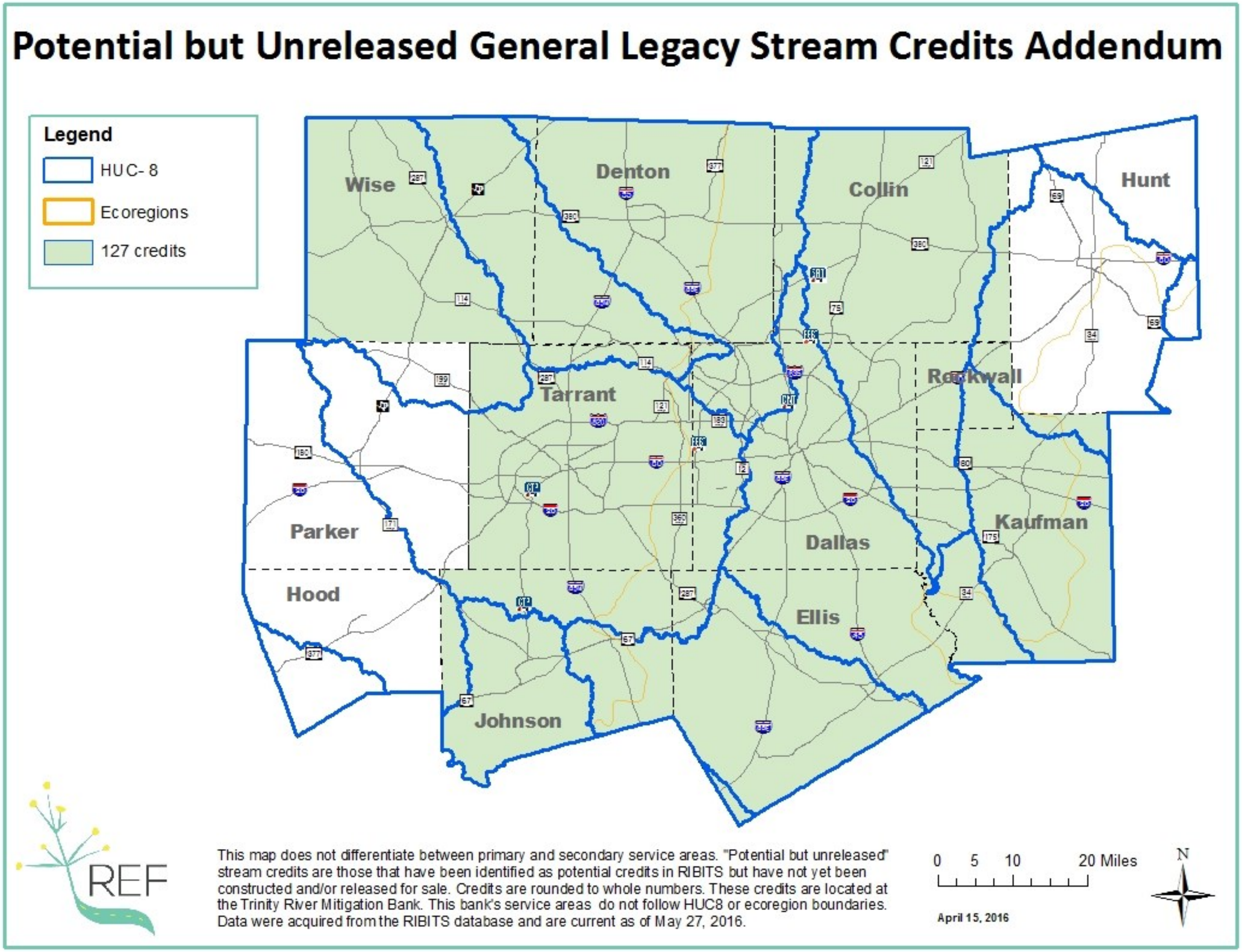


Figure A.46 Potential stream mitigation credits, combined service areas, potential but unreleased general legacy stream credits addendum

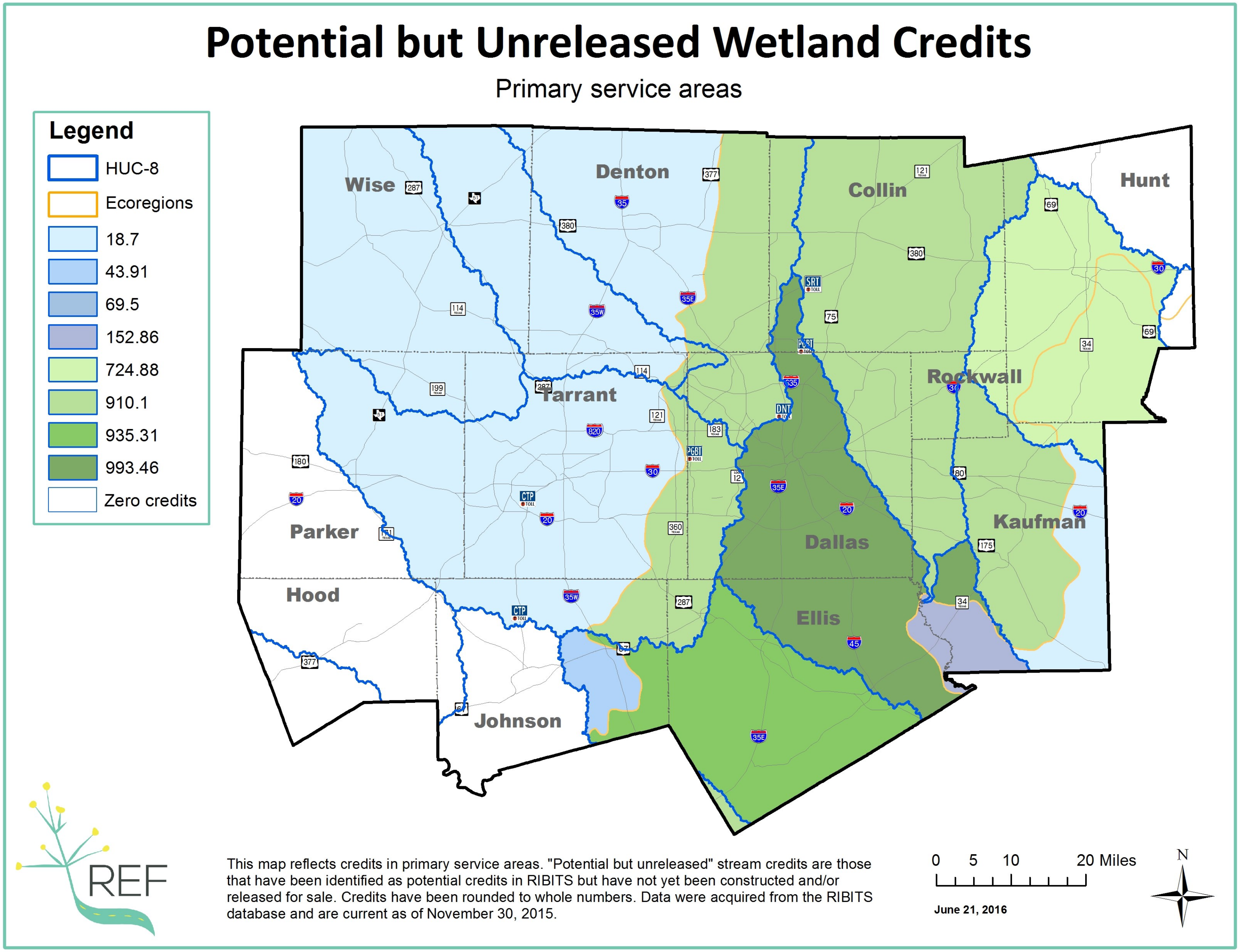


Figure A.47 Potential wetland mitigation credits, primary service areas, potential but unreleased wetland credits

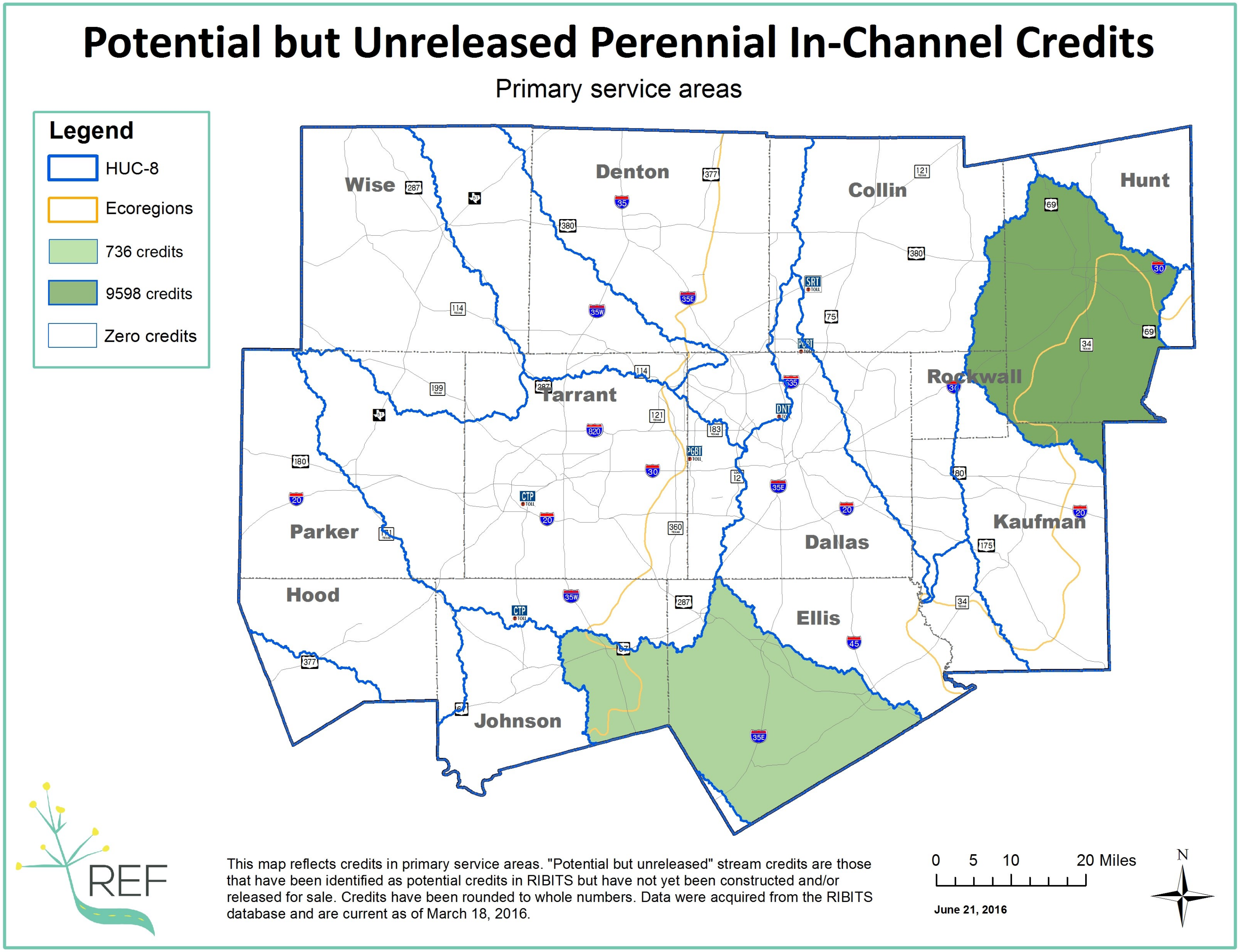


Figure A.48 Potential wetland mitigation credits, primary service areas, potential but unreleased perennial in-channel credits

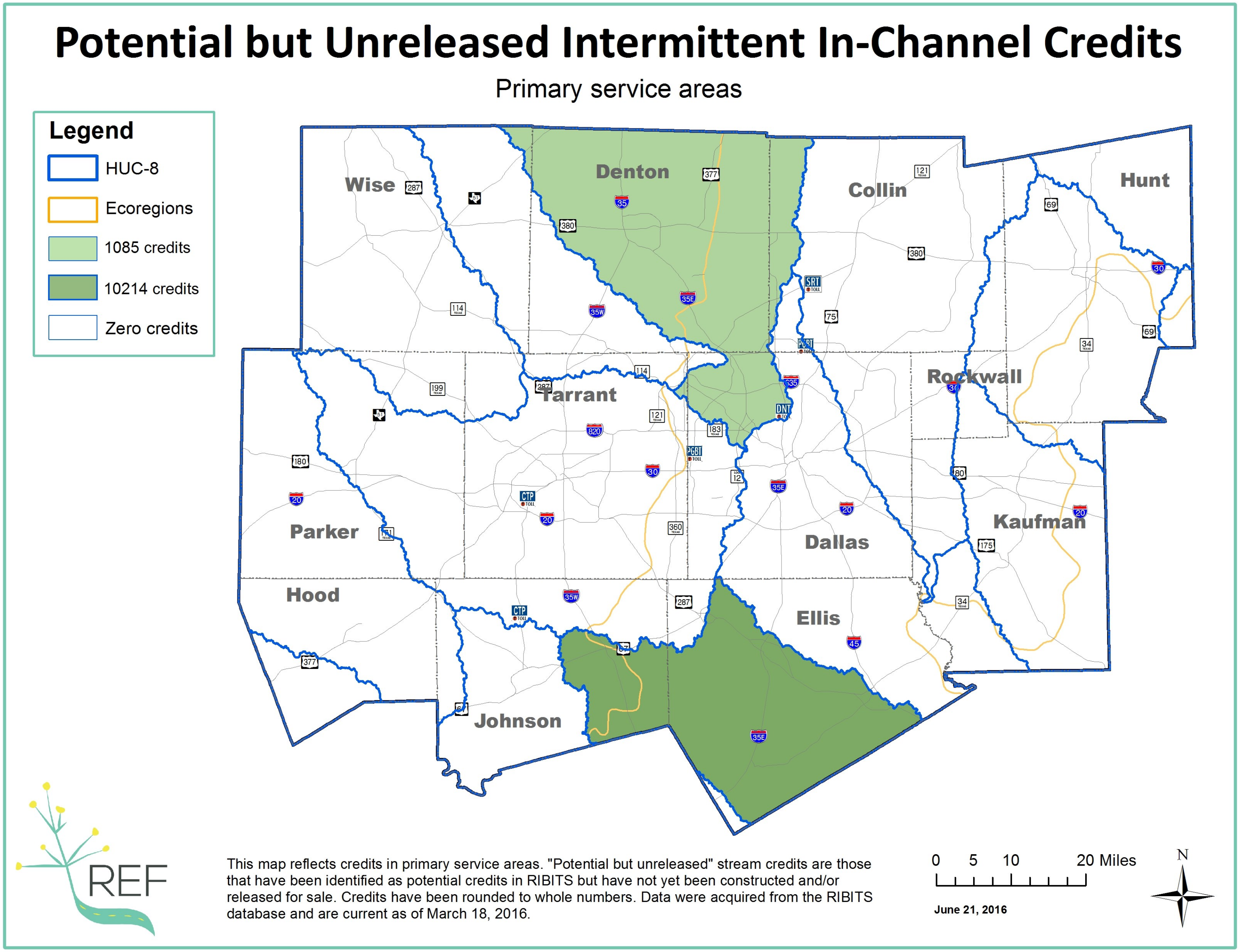


Figure A.49 Potential wetland mitigation credits, primary service areas, potential but unreleased intermittent in-channel credits

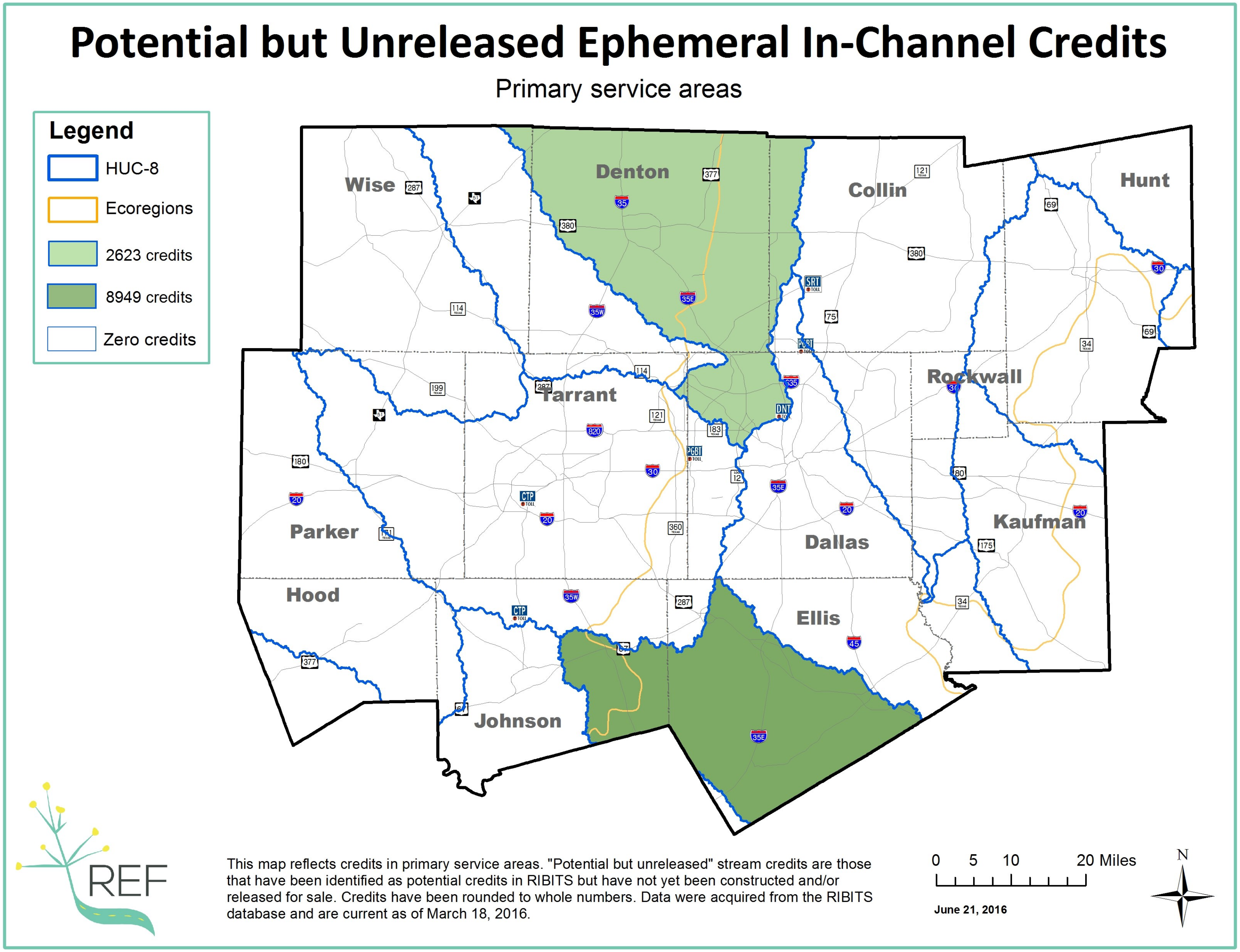


Figure A.50 Potential wetland mitigation credits, primary service areas, potential but unreleased ephemeral in-channel credits

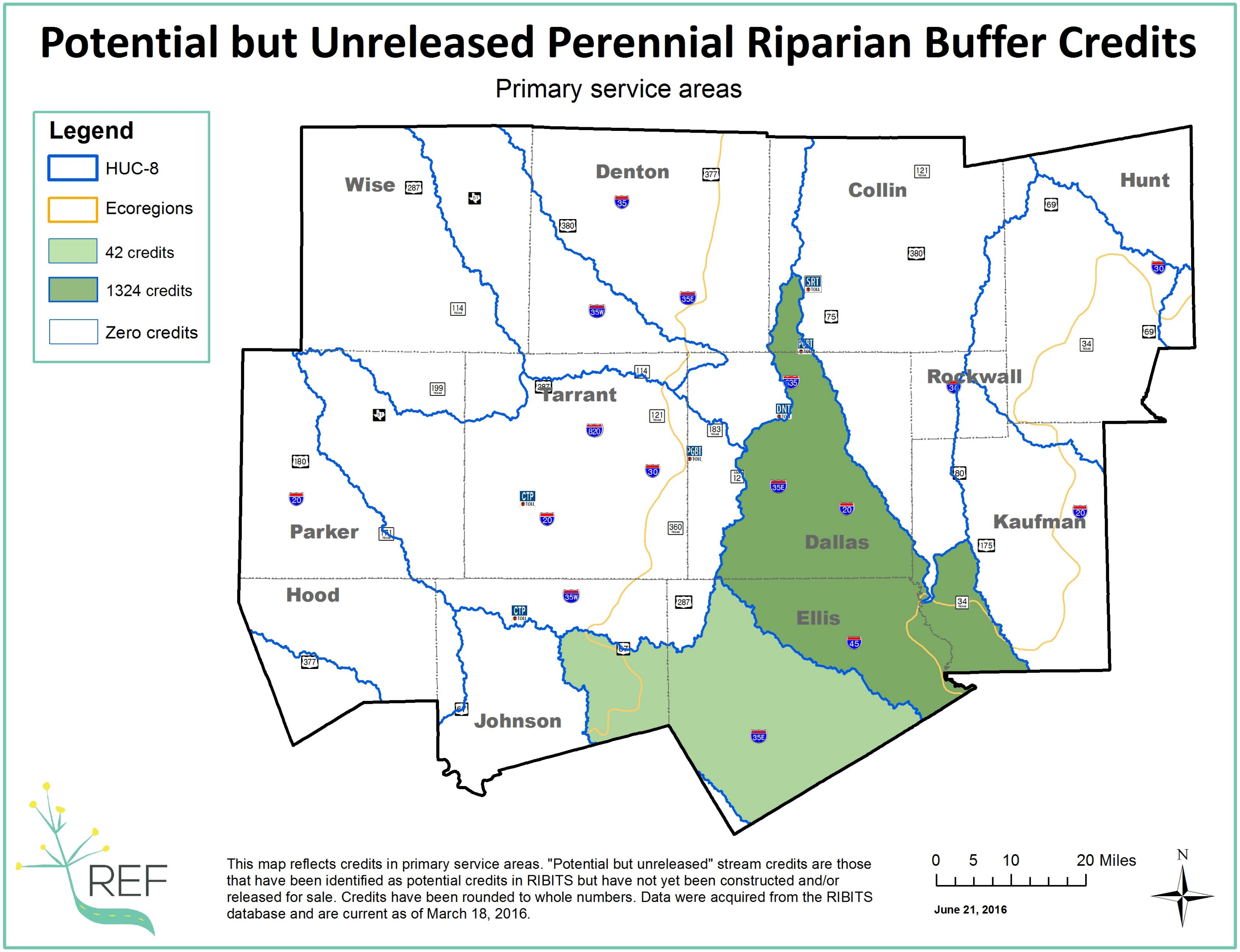


Figure A.51 Potential wetland mitigation credits, primary service areas, potential but unreleased perennial riparian buffer credits

Potential Stream Mitigation Credits, Primary Service Areas

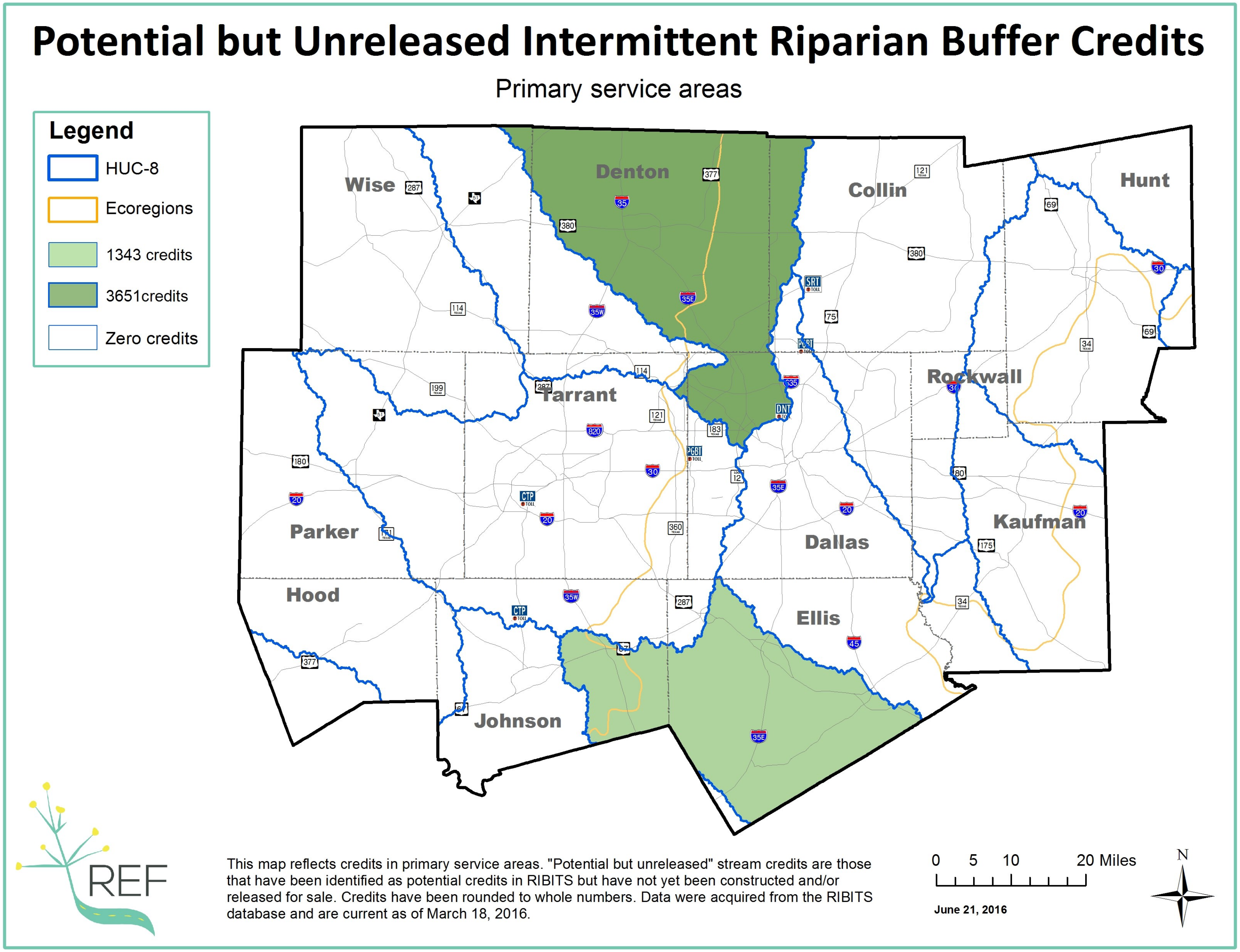


Figure A.52 Potential wetland mitigation credits, primary service areas, potential but unreleased intermittent riparian buffer credits

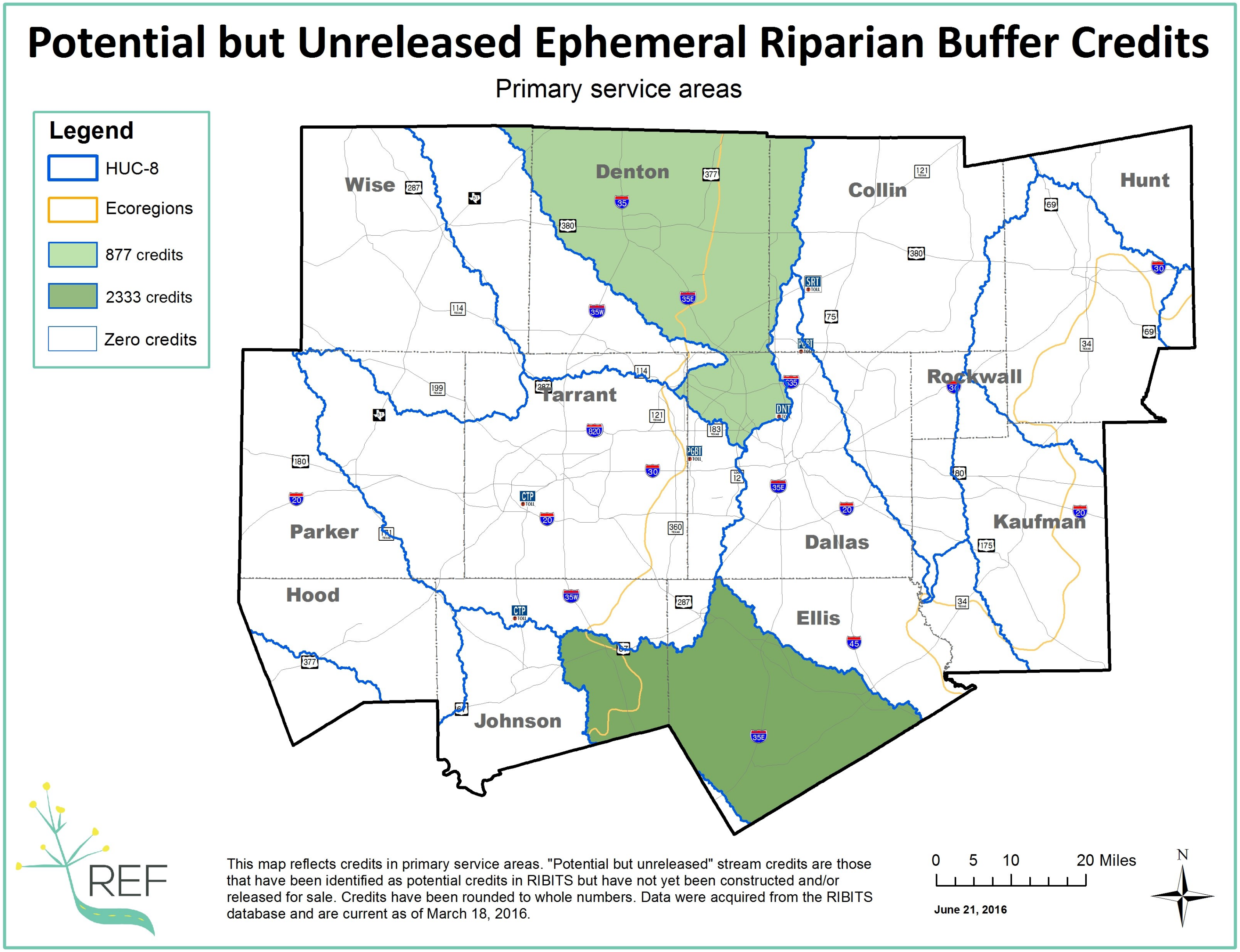


Figure A.53 Potential wetland mitigation credits, primary service areas, potential but unreleased ephemeral riparian buffer credits

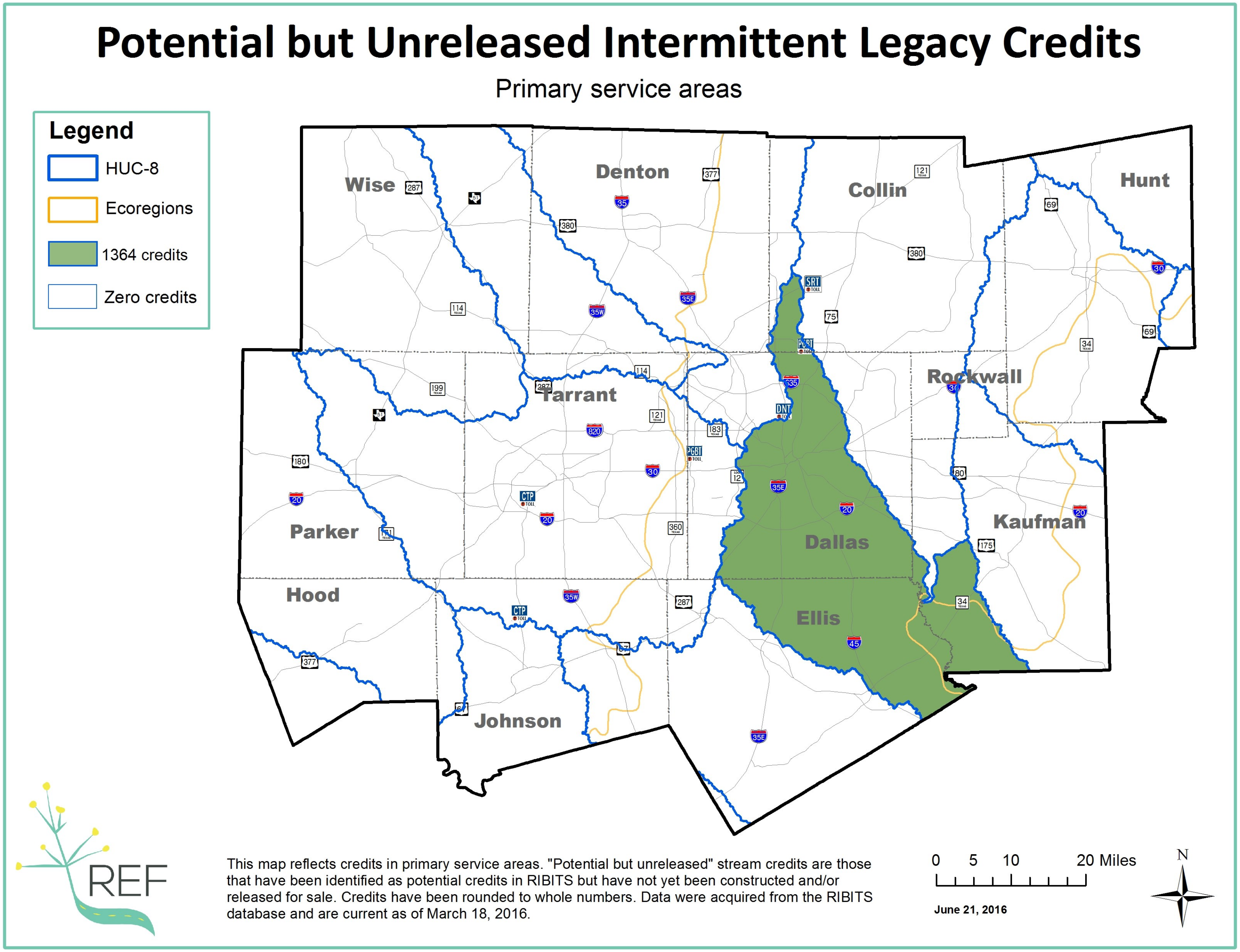


Figure A.54 Potential wetland mitigation credits, primary service areas, potential but unreleased intermittent legacy credits

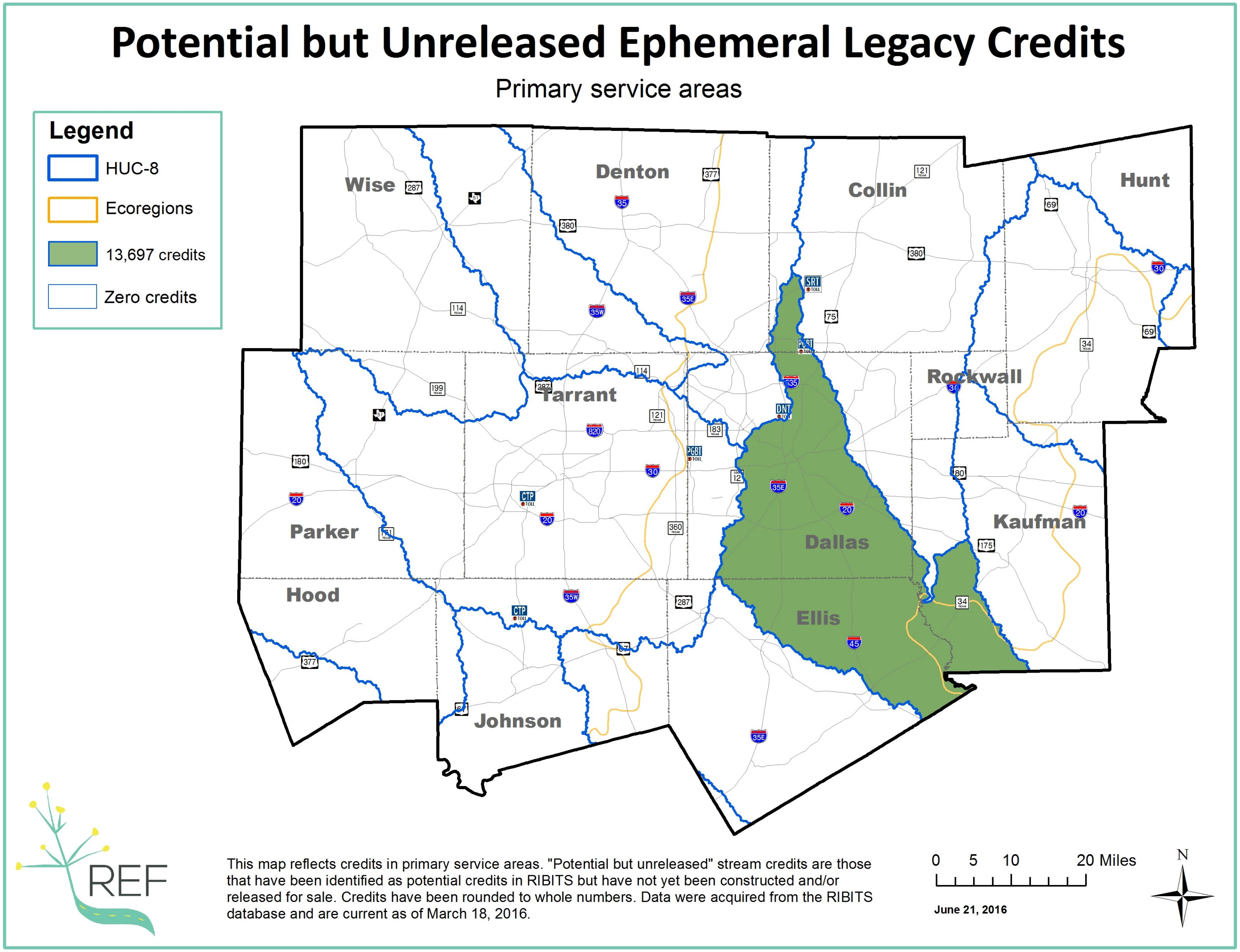


Figure A.55 Potential wetland mitigation credits, primary service areas, potential but unreleased ephemeral legacy credits

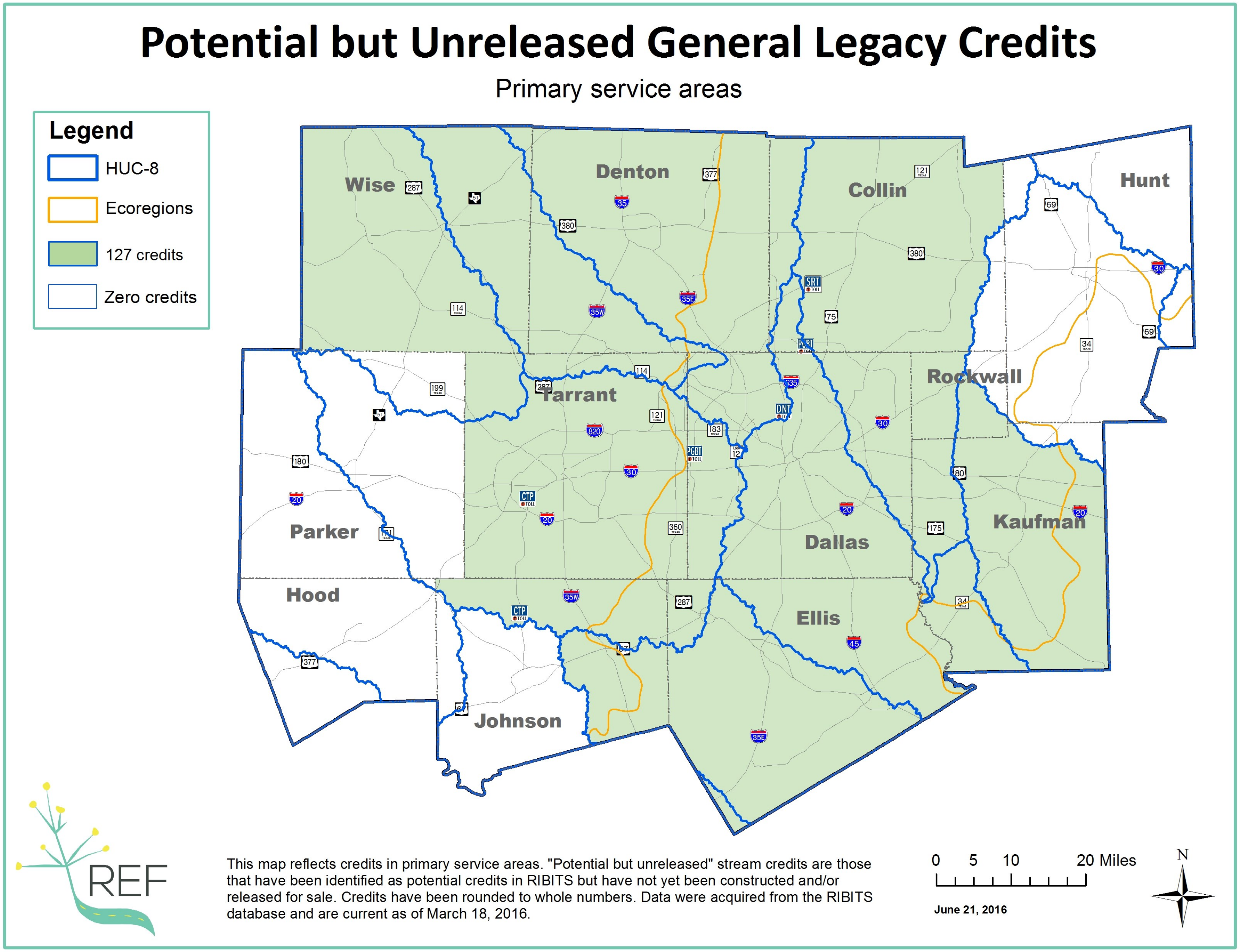


Figure A.56 Potential general legacy stream credits, primary service areas, potential but unreleased general legacy credits

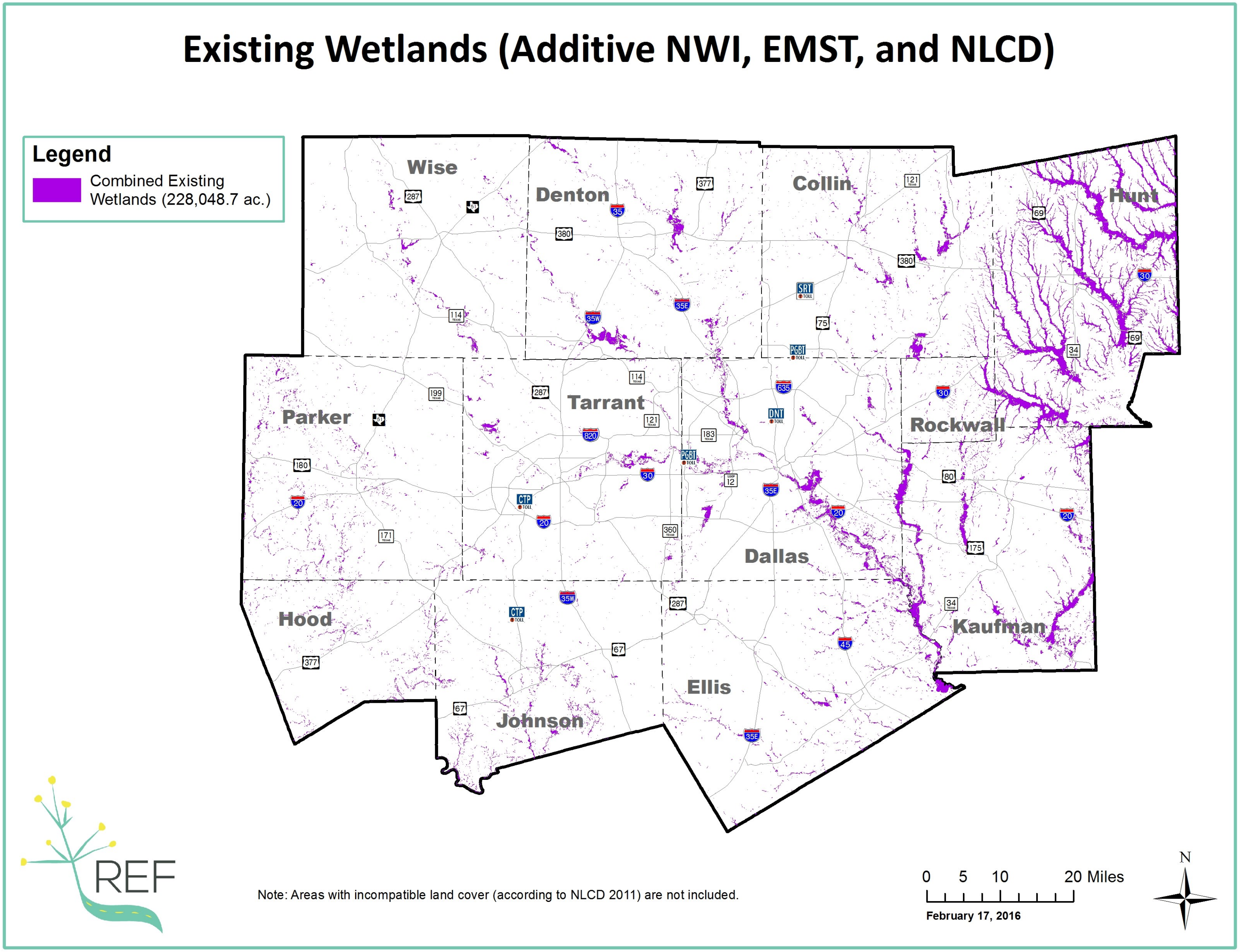


Figure A.57 Combined Existing Wetlands, All Sources, Existing Wetlands (Additive NWI, EMST, and NLCD)

Combined Existing Wetlands, Greatest Likelihood

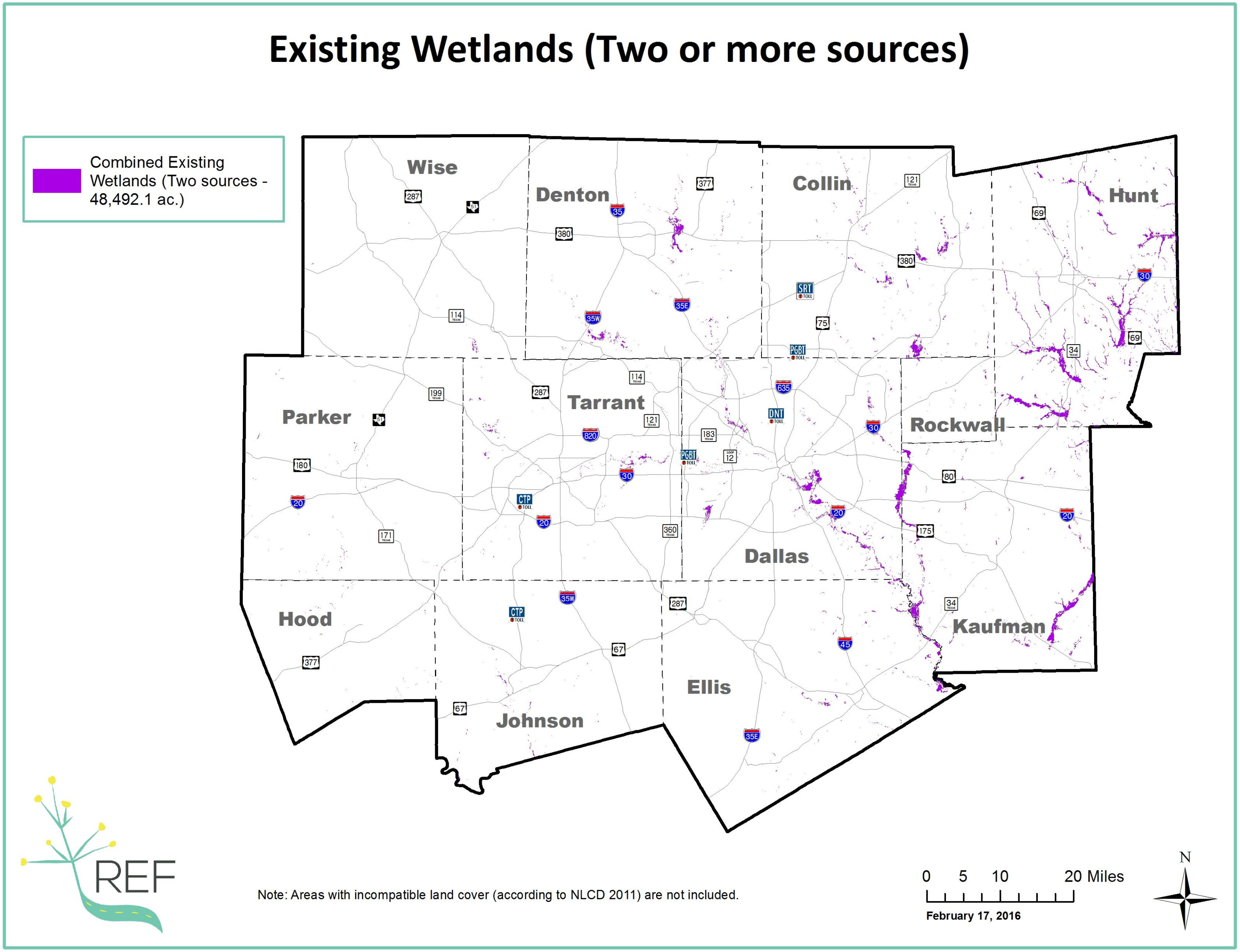


Figure A.58 Combined existing wetlands, greatest likelihood, existing wetlands (two or more sources)

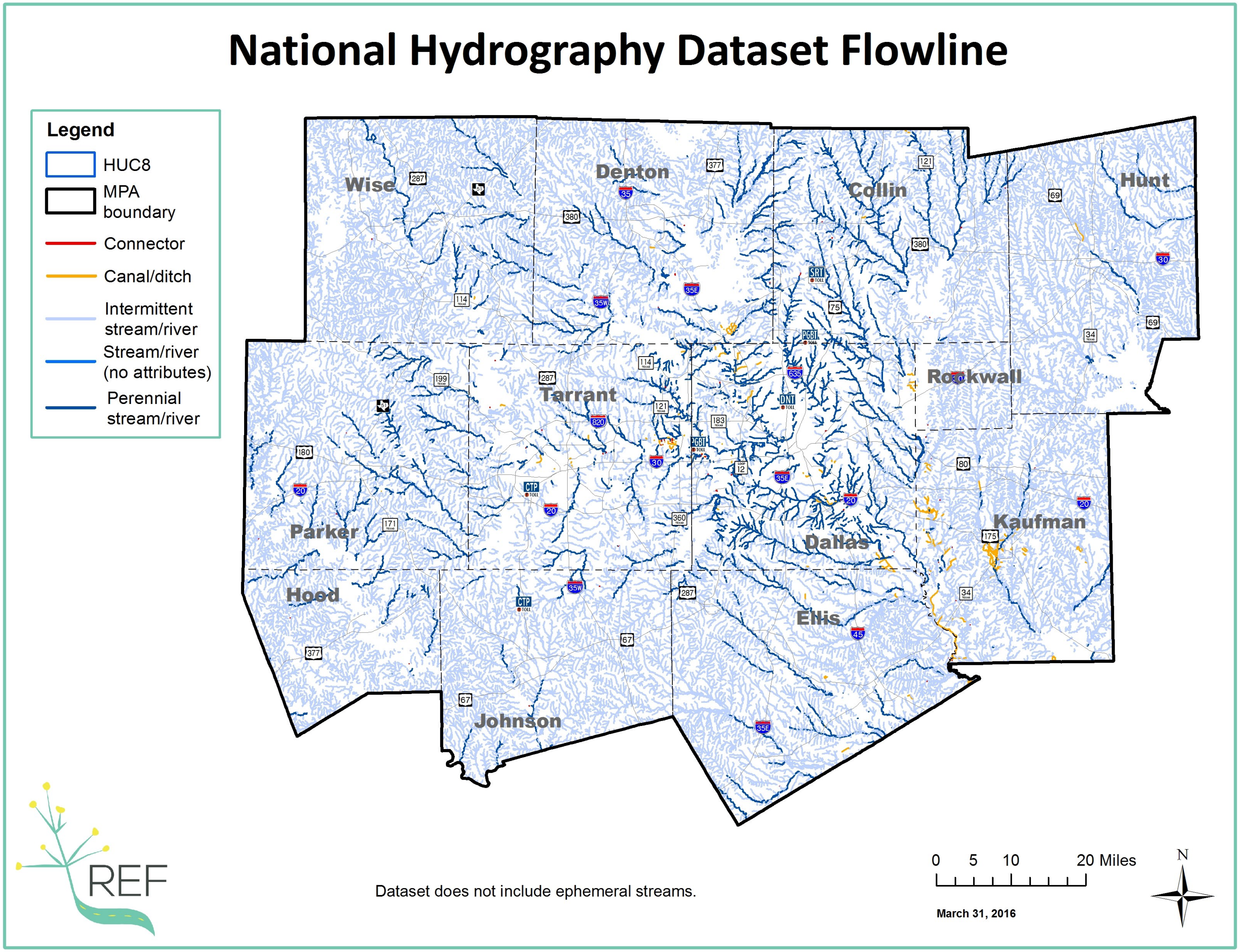


Figure A.59 Existing perennial and intermittent streams, national hydrography dataset flowline

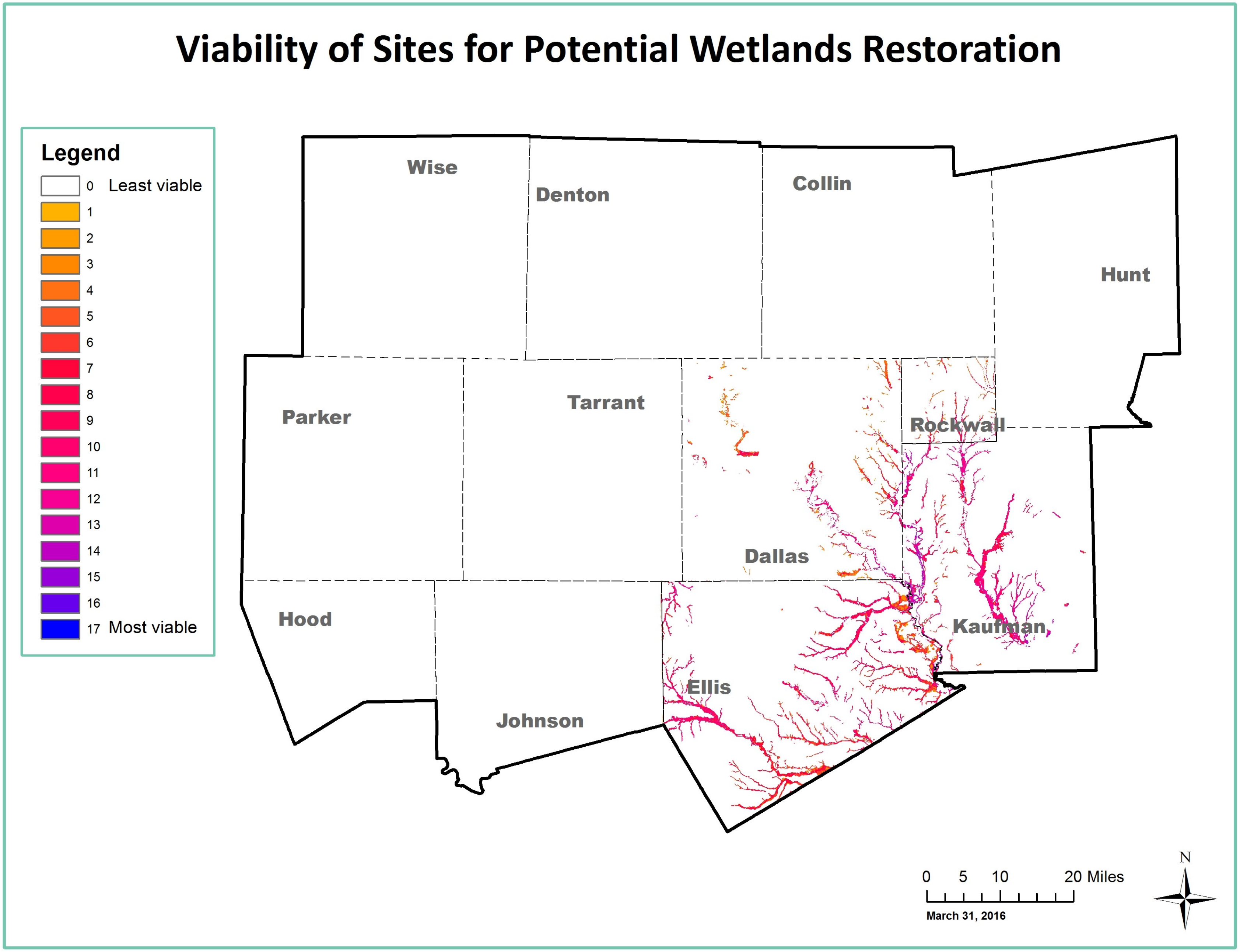


Figure A.60 Potential wetland restoration mitigation bank sites, viability of sites for potential wetlands restoration

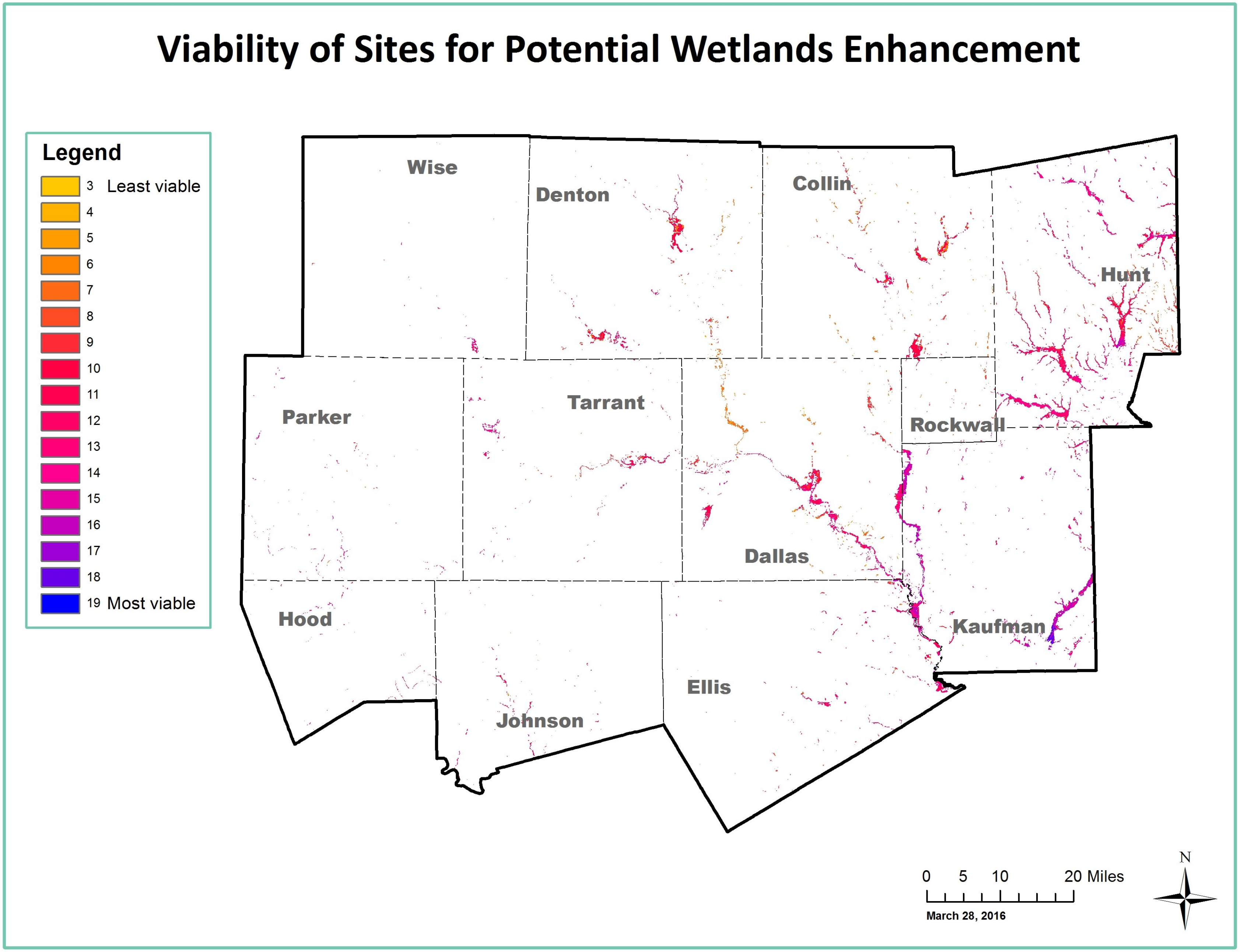


Figure A.61 Potential wetland enhancement mitigation bank sites, viability of sites for potential wetlands enhancement

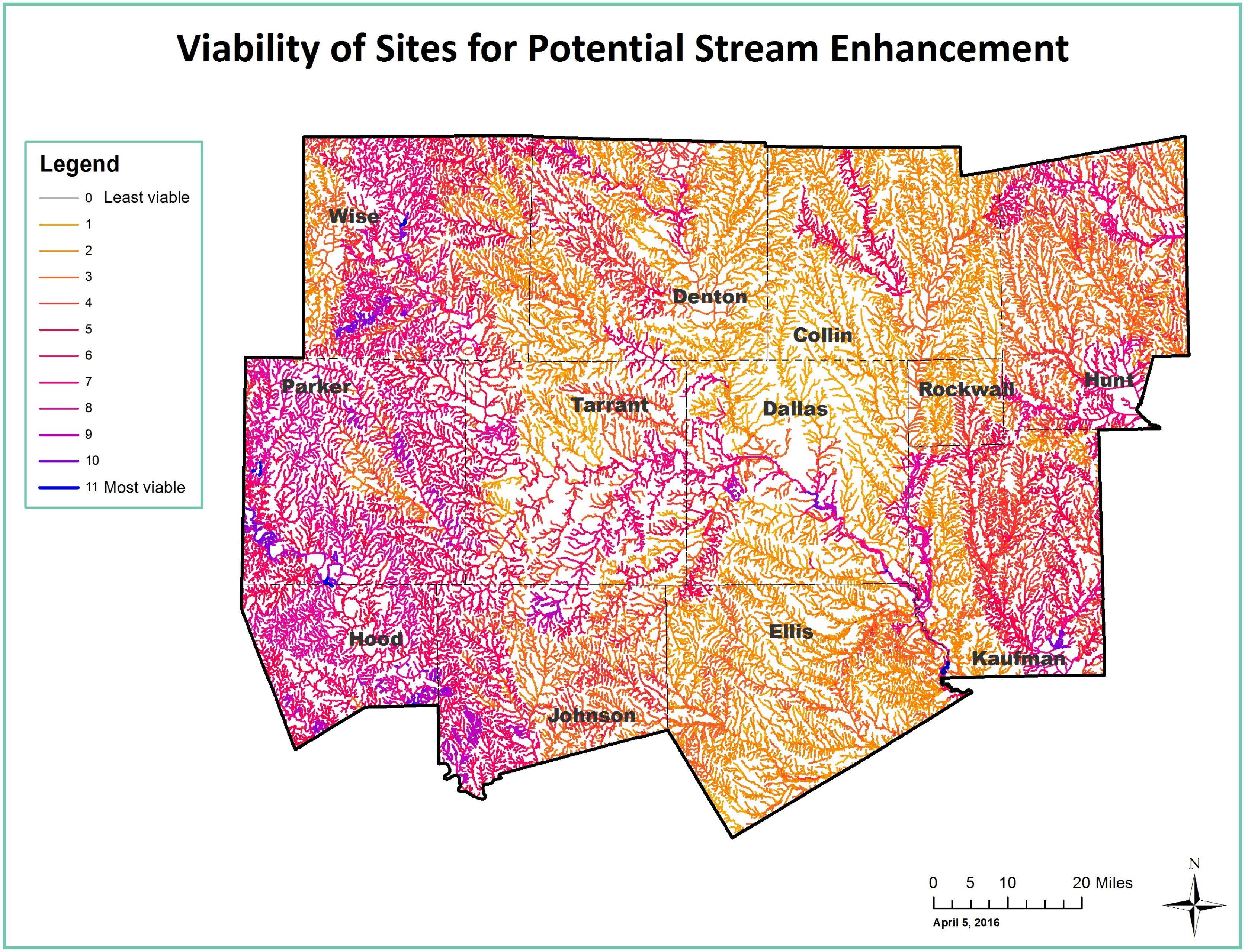


Figure A.62 Potential stream enhancement mitigation bank sites, viability of sites for potential stream enhancement

Discussion of Estimated Credit Demand Generated by Mobility 2040

NCTCOG estimated the credit demand generated by roadway projects expected to be completed by 2027 and 2040. The demand was estimated for wetland, perennial, and intermittent stream credits. This analysis could not be conducted for ephemeral streams because spatial data for this type of stream does not exist for the region.

New roadway projects, such as the Outer Loop in Denton and Collin counties, the East Branch in Dallas County, and Loop 9, the majority of which runs through Dallas County, predictably generated the highest estimated demand. Some projects to widen existing roadways did fall into the high demand category.

A qualitative analysis of these estimated demands finds that:

- By 2027, the highest estimated demand for wetland credits will be generated in HUC-8 watersheds in Denton and Dallas counties. Medium estimated demand for wetland credits will be generated in HUC-8 watersheds in Ellis, Rockwall, and Collin counties. Projects in other counties are expected to generate low to no demand for wetland credits.
- By 2040, the highest estimated demand for wetland credits will expand to roadway projects in HUC-8 watersheds in Collin, Hunt, and Kaufman counties.
- By 2027, the highest estimated demand for perennial stream credits will be generated in HUC-8 watersheds in Denton, Collin, and Dallas counties. Medium estimated demand for perennial stream credits will be generated in HUC-8 watersheds in Tarrant and Ellis counties. Projects in other counties are expected to generate low to no demand for perennial stream credits.
- By 2040, the highest estimated demand for perennial stream credits will expand to roadway projects in HUC-8 watersheds in Tarrant and Johnson counties.
- By 2027, the highest estimated demand for intermittent stream credits will be generated in HUC-8 watersheds in Denton, Collin, Dallas, Rockwall, Tarrant, and Ellis counties. Medium estimated demand for intermittent stream credits will be generated in HUC-8 watersheds in Parker County. Projects in other counties are expected to generated low to no demand for intermittent stream credits.
- By 2040, the medium estimated demand for intermittent stream credits will expand to Hunt and Johnson counties.

The potential credit demand generated by Mobility 2040 roadway projects by 2027 and 2040 were overlaid on appropriate layers from the Regional Ecosystem Framework (REF). The REF is a tool that identifies areas of relative ecological importance in the Dallas-Fort Worth region.

While the REF illustrates quantity of environmental and ecological resources, stakeholders thought its layers could be used to help conceptualize the quality of the areas being impacted. This helps the Mitigation Assessment address part of the functional assessment used by the USACE Fort Worth District as it determines the number of credits required to compensate for unavoidable impacts to wetlands and streams.

Descriptions of the REF layers used in this qualitative analysis can be found in Appendix B – Methods.

Wildlife Habitat

Wetland impacts: By 2027, roadway projects generating the highest estimated demand for wetland credits travel through areas of average wildlife habitat score. Projects with medium and low estimated wetland demand tend to be located in urban areas with low wildlife habitat scores. Even by 2040, roadway projects tend to travel through areas of average to low wildlife habitat scores.

Perennial stream impacts: By 2027, roadway projects generating the highest demand for perennial steam credits travel through areas with above average wildlife habitat scores. Projects with medium and low estimated perennial stream demand typically travel through urban areas with average to low wildlife habitat scores. But by 2040, roadway projects with the highest estimated demand for perennial stream credits travel through areas with a relatively high wildlife habitat scores.

Intermittent stream impacts: By 2027, roadway projects generating the highest estimated demand for intermittent stream credits travel through areas with average to below-average wildlife habitat scores. By 2040, however, projects with the highest estimated demand for intermittent stream credits travel through areas with average or higher wildlife habitat scores.

Diversity

Wetland impacts: By 2027, roadway projects generating high and medium estimated demand for wetland credits travel through areas with low to average diversity scores. Roadway projects generated low estimated demand travel through areas with low diversity scores, except for a project that travels through western Tarrant and eastern Parker counties. By 2040, however, projects generating high estimated demand for wetland credits travel through areas with average to high diversity scores. Medium- and low-impact projects travel through areas with low diversity scores.

Perennial stream impacts: By 2027, roadway projects in general travel through areas with low to average diversity scores. But by 2040, some roadway projects generating high estimated demand will travel through areas with high diversity scores. Roadway projects generating medium estimated demand will travel through areas with low to medium diversity scores. Low-impact projects will generally be confined to areas with low diversity scores.

Intermittent stream impacts: By 2027, high-impact and medium-impact roadway projects will travel through areas with a mix of low to medium diversity scores. Most low-impact roadway projects will travel through areas with low diversity scores. The results are similar for roadway projects completed by 2040.

Rarity

Wetland impacts: By 2027, the majority of roadway projects generating high and medium wetland impacts will travel through areas of average to high rarity scores. Most low-impact projects travel through areas with low rarity scores. By 2040, a greater number of high-impact roadway segments will have been constructed in areas with above-average rarity scores. Projects with estimated medium wetland impacts tend to be located in areas with average rarity. Low-impact projects again tend to travel through areas with low rarity scores.

Perennial stream impacts: By 2027, many of the high- and medium-impact roadway projects travel through areas with above-average and high rarity scores. Low-impact projects also tend to travel through areas with above-average rarity scores. These patterns continue for projects constructed through 2040.

Intermittent stream impacts: By 2027, many of the roadway projects estimated to have medium and high impacts on intermittent streams travel through areas with above average to high rarity scores. Most low-impact projects travel through areas with average rarity scores, though some pass through areas with high scores.

Sustainability

This analysis was only conducted for wetland impacts. By 2027, the majority of roadway projects with any estimated impact on wetlands travel through areas with low sustainability scores. This generally holds true for projects completed by 2040, although a project traveling through Hunt County that is estimated to create high impacts travels through areas with high sustainability scores.

Wetland Credit Demand Generated by Mobility 2040 Roadway Projects

Mobility 2040 Project Impacts (2017-2027 Only)

Corridor Number	Corridor Name	Type	HUC 8	Total Miles	Wetlands (most inclusive) Acreage	Impact (Percentiles)
2	DFW Connector	W	12030102	1.813449441		None
2	DFW Connector	W	12030103	0.771110819		None
2	DFW Connector	W	12030104	4.827886668	0.291838039	Low
3	DNT Extension	NL	12030103	13.92908781	2.133383764	Medium
4	DNT Widening	W	12030103	3.382111546	0.049844183	Low
4	DNT Widening	W	12030105	6.317240589	0.026568017	Low
5	East Branch	NL	12030106	11.21894565	186.6714616	High
6	IH 20 - Dallas County	CM	12030102	6.719880638	3.286466673	Medium
6	IH 20 - Dallas County	CM	12030105	8.035830933	31.46131374	High
7	IH 20 - Parker County	CM	12030102	7.382922676	0.008979454	Low
8	IH 20 - Tarrant County	CM	12030102	6.881663501	0.030563751	Low
9	IH 30 East	W	12010001	6.548474599	3.032630896	Medium
9	IH 30 East	W	12030106	2.614896764		None
9	IH 30 East	W	12030107	1.450990491	0.329142856	Low
11	IH 30 - Tarrant County	W	12030102	0.907518209		None
12	IH 30 - West Freeway	CM	12030102	11.08484378	0.374104723	Low
13	IH 35/IH 35W - North	W	12030103	1.784082476		None
14	IH 35E - Ellis County	W	12030105	4.133824817		None
14	IH 35E - Ellis County	W	12030108	1.489439783	0.083815074	Low
14	IH 35E - Ellis County	W	12030109	24.00903899	0.755744818	Medium
15	IH 35E - Lowest Stemmons	CM	12030105	2.017584367		None
16	IH 35E North	W	12030103	28.99068772	11.00780894	High
19	IH 820 East	W	12030102	4.298974619	0.386087732	Low
21	LBJ East	W	12030105	6.272522076		None
21	LBJ East	W	12030106	4.640939494	0.325130525	Low
23	Loop 12	W	12030103	2.59887646	1.861934839	Medium
24	Loop 9	NL	12030102	0.041255168		None
24	Loop 9	NL	12030105	27.77561301	44.7577459	High
24	Loop 9	NL	12030106	6.197484082	90.66178148	High
24	Loop 9	NL	12030109	0.997611843		None
25	Midtown Express (SH 183)	W	12030102	10.61542471	0.33760196	Low
25	Midtown Express (SH 183)	W	12030103	3.376454283	1.587999985	Medium
25	Midtown Express (SH 183)	W	12030105	0.748330397		None
26	North Tarrant Express (IH 35W)	W	12030102	11.83959186		None
26	North Tarrant Express (IH 35W)	W	12030104	3.861036476		None
27	North Tarrant Express (IH 820/SH 121/SH 183)	W	12030102	11.26459867		None
28	Outer Loop	NL	12030103	24.82616832	9.761018428	High
28	Outer Loop	NL	12030106	15.55396115	1.092833424	Medium
29	PGBT (IH 35E -IH 635)	W	12030103	5.40555007	3.421574961	High
30	PGBT Widening	W	12030103	6.531859624	0.007398227	Low
30	PGBT Widening	W	12030105	0.35642936		None
30	PGBT Widening	W	12030106	6.863816596		None
31	PGBT - WE/SH 161	W	12030102	8.17143326	0.042286719	Low
31	PGBT - WE/SH 161	W	12030103	4.838616024		None
32	Sam Rayburn Tollway	W	12030103	11.97775155	0.465290662	Low
32	Sam Rayburn Tollway	W	12030104	2.596325683		None
32	Sam Rayburn Tollway	W	12030105	3.077184622		None
32	Sam Rayburn Tollway	W	12030106	7.644521843	0.087431472	Low
34	SH 114 - Denton County	W	12030104	2.817034732	0.133073266	Low
38	SH 199	W	12030101	1.281860952		None
38	SH 199	W	12030102	7.443138321	0.230121983	Low
40	SH 360 Widening	W	12030102	5.690854419		None
42	Southern Gateway (IH 35E/US 67)	W	12030105	14.6045695		None
43	Trinity Parkway	NL	12030105	0.743254979	3.698143527	High
45	US 287 - Ellis County	W	12030105	0.191654881		None
45	US 287 - Ellis County	W	12030109	4.328942123		None
46	US 75 - North Collin County	W	12030106	7.861732812	0.475477834	Medium
47	US 75 - South Collin County	CM	12030106	7.558803223	0.156545	Low
48	US 80	W	12030105	0.304600338		None
48	US 80	W	12030106	15.42872068	4.356623537	High
48	US 80	W	12030107	3.173090551	1.631380458	Medium

Table A.2 Wetland credit demand generated by Mobility 2040 Roadway Projects, 2017-2027

Wetland Credit Demand Generated by Mobility 2040 Roadway Projects

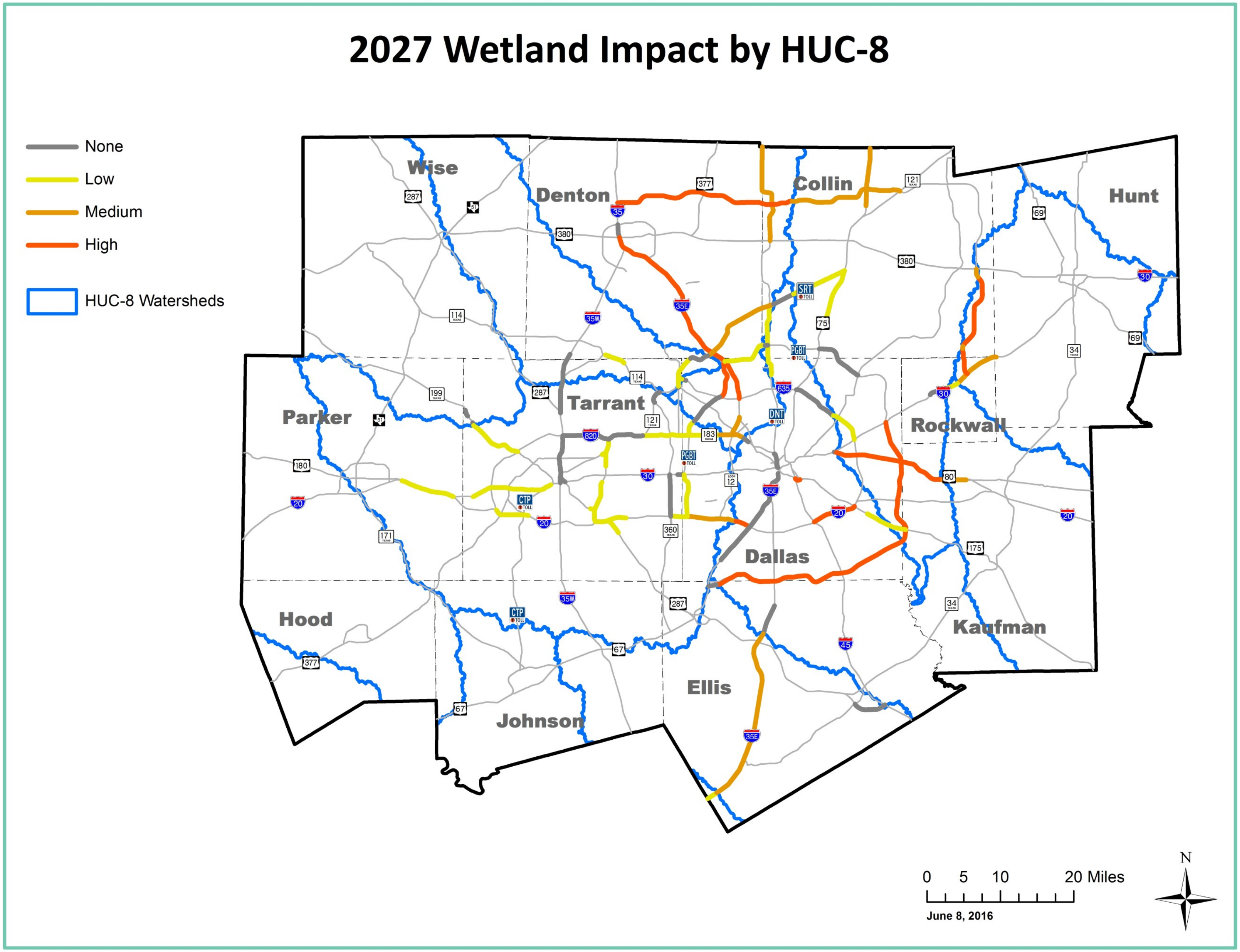


Figure A.63 Wetland credit demand generated by Mobility 2040 roadway projects, 2027 wetland impact by HUC-8

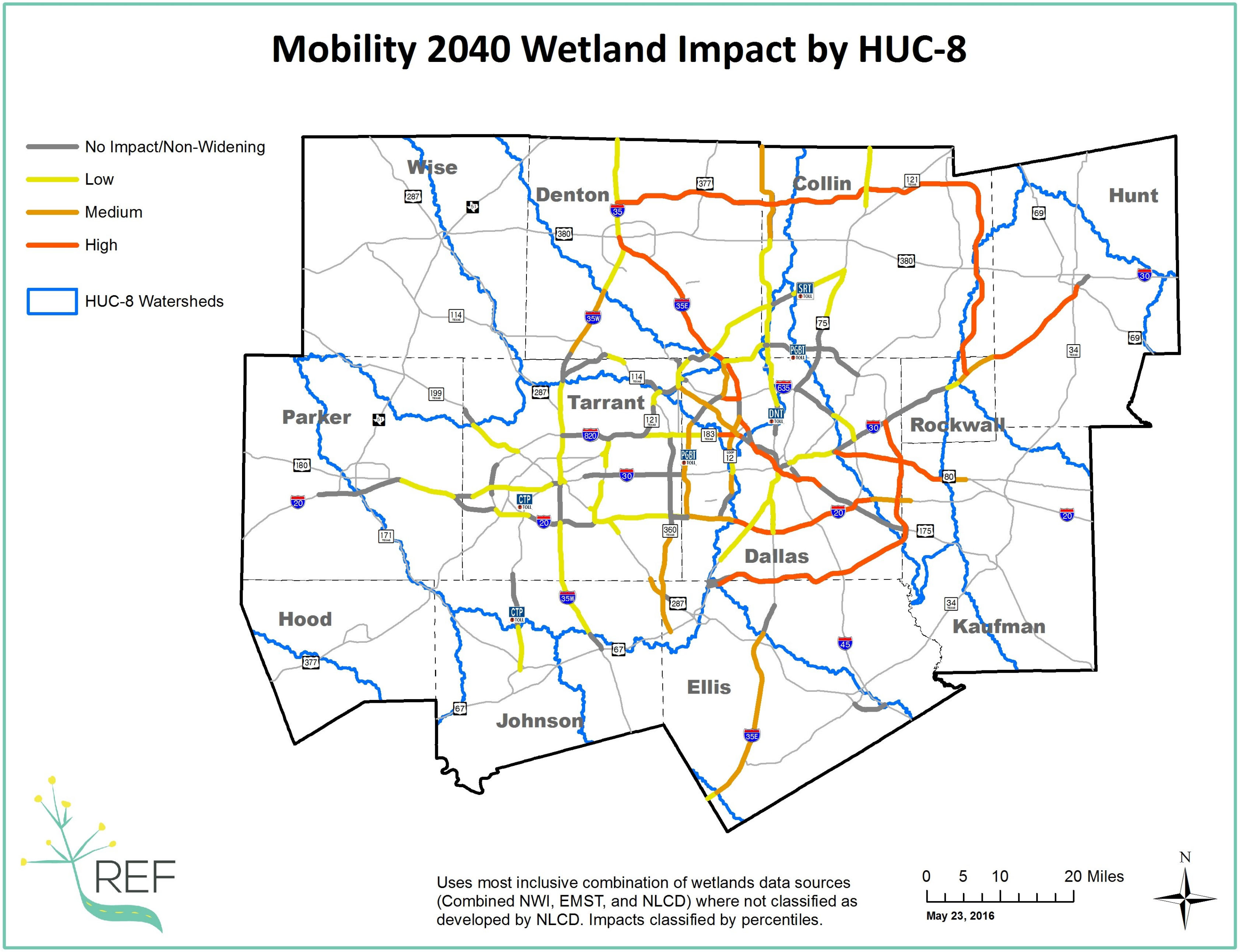


Figure A.64 Wetland credit demand generated by Mobility 2040 roadway projects, 20240 wetland impact by HUC-8

Stream Credit Demand Generated by Mobility 2040 Roadway Projects

Mobility 2040 Project Impacts (2017-2027 Only)

Corridor Number	Corridor Name	Type	HUC 8	Total Miles	Perennial Streams Length (feet)	Perennial Streams Impact (Percentiles)
2	DFW Connector	W	12030102	1.813449441		None
2	DFW Connector	W	12030103	0.771110819		None
2	DFW Connector	W	12030104	4.827886668	176.4541815	Low
3	DNT Extension	NL	12030103	13.92908781	2203.888481	High
4	DNT Widening	W	12030103	3.382111546	24.00310409	Low
4	DNT Widening	W	12030105	6.317240589	106.1810801	Low
5	East Branch	NL	12030106	11.21894565	5440.899546	High
6	IH 20 - Dallas County	CM	12030102	6.719880638	510.9848636	Medium
6	IH 20 - Dallas County	CM	12030105	8.035830933	763.7889737	High
7	IH 20 - Parker County	CM	12030102	7.382922676	97.25253732	Low
8	IH 20 - Tarrant County	CM	12030102	6.881663501	50.27524717	Low
9	IH 30 East	W	12010001	6.548474599		None
9	IH 30 East	W	12030106	2.614896764		None
9	IH 30 East	W	12030107	1.450990491		None
11	IH 30 - Tarrant County	W	12030102	0.907518209	454.270876	Medium
12	IH 30 - West Freeway	CM	12030102	11.08484378		None
13	IH 35/IH 35W - North	W	12030103	1.784082476		None
14	IH 35E - Ellis County	W	12030105	4.133824817		None
14	IH 35E - Ellis County	W	12030108	1.489439783	369.4242615	Medium
14	IH 35E - Ellis County	W	12030109	24.00903899	533.9635865	Medium
15	IH 35E - Lowest Stemmons	CM	12030105	2.017584367	60.23520057	Low
16	IH 35E North	W	12030103	28.99068772	2537.793125	High
19	IH 820 East	W	12030102	4.298974619	480.614986	Medium
21	LBJ East	W	12030105	6.272522076	811.7759474	High
21	LBJ East	W	12030106	4.640939494	448.7009328	Medium
23	Loop 12	W	12030103	2.59887646	53.37068264	Low
24	Loop 9	NL	12030102	0.041255168		None
24	Loop 9	NL	12030105	27.77561301	5469.974236	High
24	Loop 9	NL	12030106	6.197484082	36.22814478	Low
24	Loop 9	NL	12030109	0.997611843		None
25	Midtown Express (SH 183)	W	12030102	10.61542471	578.7230729	Medium
25	Midtown Express (SH 183)	W	12030103	3.376454283		None
25	Midtown Express (SH 183)	W	12030105	0.748330397	104.0002472	Low
26	North Tarrant Express (IH 35W)	W	12030102	11.83959186	241.162029	Low
26	North Tarrant Express (IH 35W)	W	12030104	3.861036476	112.4645992	Low
27	North Tarrant Express (IH 820/SH 121/SH 183)	W	12030102	11.26459867	231.1764999	Low
28	Outer Loop	NL	12030103	24.82616832	3160.75609	High
28	Outer Loop	NL	12030106	15.55396115	4476.912098	High
29	PGBT (IH 35E -IH 635)	W	12030103	5.40555007	570.2514374	Medium
30	PGBT Widening	W	12030103	6.531859624	178.6851484	Low
30	PGBT Widening	W	12030105	0.35642936		None
30	PGBT Widening	W	12030106	6.863816596	48.8821931	Low
31	PGBT - WE/SH 161	W	12030102	8.17143326		None
31	PGBT - WE/SH 161	W	12030103	4.838616024	50.99299731	Low
32	Sam Raybum Tollway	W	12030103	11.97775155	90.70612576	Low
32	Sam Raybum Tollway	W	12030104	2.596325683		None
32	Sam Raybum Tollway	W	12030105	3.077184622	174.0823708	Low
32	Sam Raybum Tollway	W	12030106	7.644521843	175.2236409	Low
34	SH 114 - Denton County	W	12030104	2.817034732		None
38	SH 199	W	12030101	1.281860952	670.6820397	High
38	SH 199	W	12030102	7.443138321		None
40	SH 360 Widening	W	12030102	5.690854419		None
42	Southern Gateway (IH 35E/US 67)	W	12030105	14.6045695	921.3163622	High
43	Trinity Parkway	NL	12030105	0.743254979		None
45	US 287 - Ellis County	W	12030105	0.191654881		None
45	US 287 - Ellis County	W	12030109	4.328942123	368.149988	Medium
46	US 75 - North Collin County	W	12030106	7.861732812	129.5733226	Low
47	US 75 - South Collin County	CM	12030106	7.558803223	203.8635525	Low
48	US 80	W	12030105	0.304600338		None
48	US 80	W	12030106	15.42872068	379.4749529	Medium
48	US 80	W	12030107	3.173090551		None

Table A.3 Perennial stream credit demand generated by Mobility 2040 Roadway Projects, 2017-2027

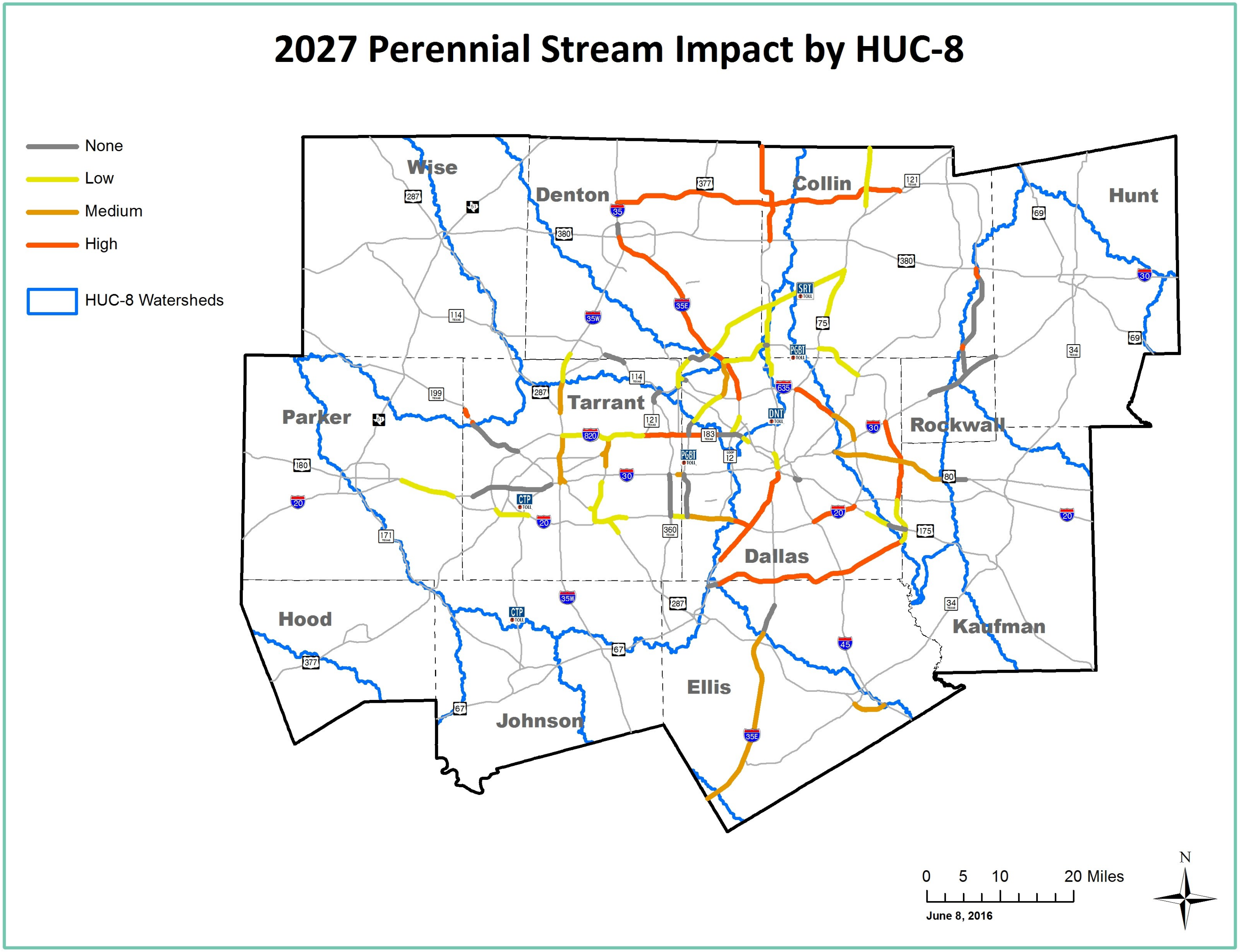


Figure A.65 Stream credit demand generated by Mobility 2040 roadway projects, 2027 perennial stream impact by HUC-8

Stream Credit Demand Generated by Mobility 2040 Roadway Projects

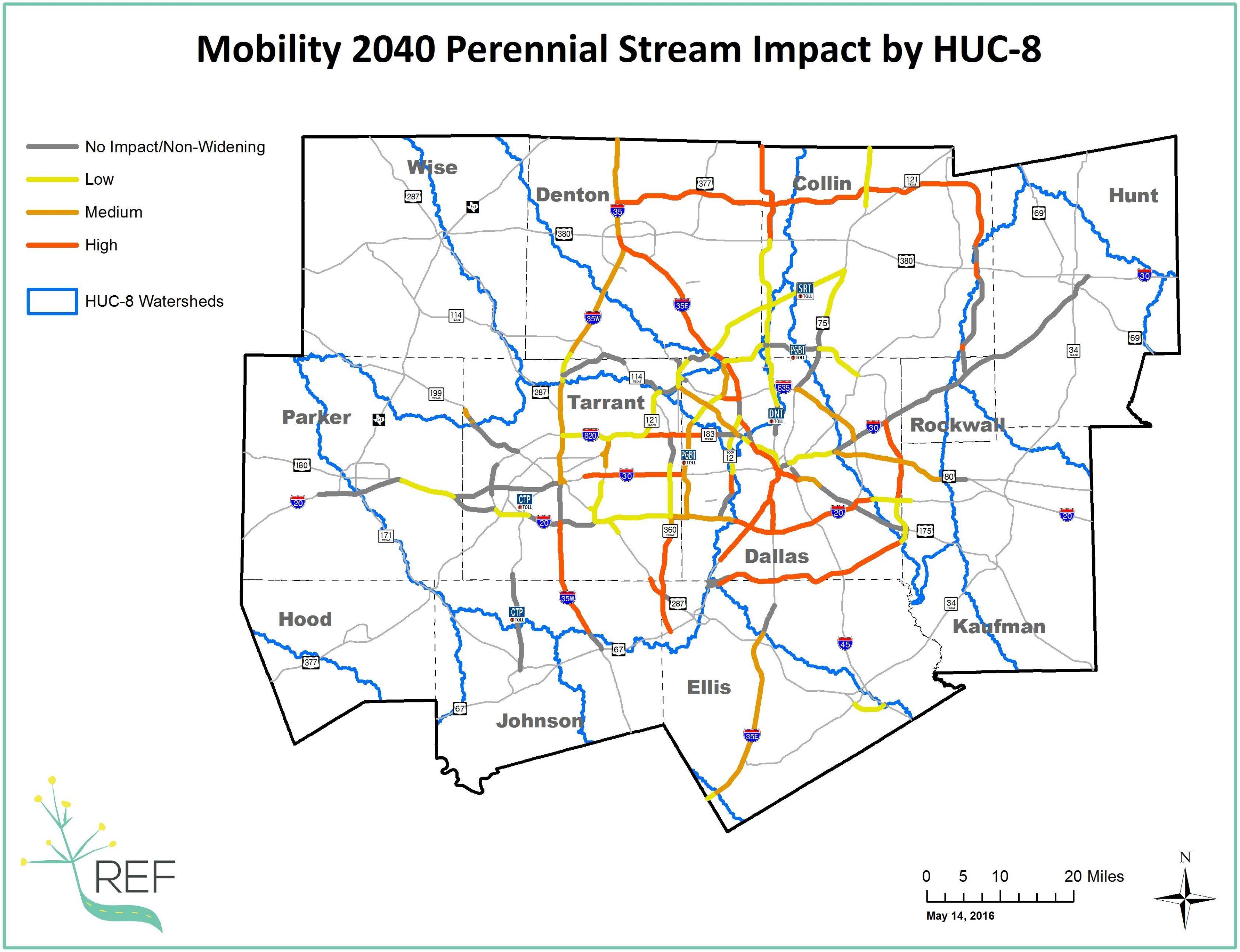


Figure A.66 Stream credit demand generated by Mobility 2040 roadway projects, Mobility 2040 perennial stream impact by HUC-8

Stream Credit Demand Generated by Mobility 2040 Roadway Projects

Mobility 2040 Project Impacts (2017-2027 Only)

Corridor Number	Corridor Name	Type	HUC 8	Total Miles	Intermittent Streams Length (feet)	Intermittent Streams Impact (Percentiles)
2	DFW Connector	W	12030102	1.813449441	105.522047	Low
2	DFW Connector	W	12030103	0.771110819		None
2	DFW Connector	W	12030104	4.827886668	738.7238951	Medium
3	DNT Extension	NL	12030103	13.92908781	11282.21114	High
4	DNT Widening	W	12030103	3.382111546	24.1232701	Low
4	DNT Widening	W	12030105	6.317240589	535.1265997	Low
5	East Branch	NL	12030106	11.21894565	14283.75792	High
6	IH 20 - Dallas County	CM	12030102	6.719880638	992.6004207	Medium
6	IH 20 - Dallas County	CM	12030105	8.035830933		None
7	IH 20 - Parker County	CM	12030102	7.382922676	861.9406351	Medium
8	IH 20 - Tarrant County	CM	12030102	6.881663501	1028.343913	Medium
9	IH 30 East	W	12010001	6.548474599	1727.270274	High
9	IH 30 East	W	12030106	2.614896764	227.978811	Low
9	IH 30 East	W	12030107	1.450990491	758.4732929	Medium
11	IH 30 - Tarrant County	W	12030102	0.907518209	65.97906254	Low
12	IH 30 - West Freeway	CM	12030102	11.08484378	406.6660018	Low
13	IH 35/IH 35W - North	W	12030103	1.784082476	44.80978848	Low
14	IH 35E - Ellis County	W	12030105	4.133824817	190.4407182	Low
14	IH 35E - Ellis County	W	12030108	1.489439783	787.9991157	Medium
14	IH 35E - Ellis County	W	12030109	24.00903899	5249.298697	High
15	IH 35E - Lowest Stemmons	CM	12030105	2.017584367		None
16	IH 35E North	W	12030103	28.99068772	4592.703504	High
19	IH 820 East	W	12030102	4.298974619	59.669421	Low
21	LBJ East	W	12030105	6.272522076	153.6149317	Low
21	LBJ East	W	12030106	4.640939494		None
23	Loop 12	W	12030103	2.59887646	341.2786963	Low
24	Loop 9	NL	12030102	0.041255168		None
24	Loop 9	NL	12030105	27.77561301	23153.85884	High
24	Loop 9	NL	12030106	6.197484082	7737.258498	High
24	Loop 9	NL	12030109	0.997611843	1797.043412	High
25	Midtown Express (SH 183)	W	12030102	10.61542471	546.3556898	Low
25	Midtown Express (SH 183)	W	12030103	3.376454283		None
25	Midtown Express (SH 183)	W	12030105	0.748330397		None
26	North Tarrant Express (IH 35W)	W	12030102	11.83959186	1896.841601	High
26	North Tarrant Express (IH 35W)	W	12030104	3.861036476	1279.399901	High
27	North Tarrant Express (IH 820/SH 121/SH 183)	W	12030102	11.26459867	867.489701	Medium
28	Outer Loop	NL	12030103	24.82616832	21968.25215	High
28	Outer Loop	NL	12030106	15.55396115	7255.121582	High
29	PGBT (IH 35E -IH 635)	W	12030103	5.40555007	49.92867843	Low
30	PGBT Widening	W	12030103	6.531859624	181.512716	Low
30	PGBT Widening	W	12030105	0.35642936		None
30	PGBT Widening	W	12030106	6.863816596	252.3415394	Low
31	PGBT - WE/SH 161	W	12030102	8.17143326	679.125674	Medium
31	PGBT - WE/SH 161	W	12030103	4.838616024	249.7173186	Low
32	Sam Rayburn Tollway	W	12030103	11.97775155	466.3606303	Low
32	Sam Rayburn Tollway	W	12030104	2.596325683	160.8536629	Low
32	Sam Rayburn Tollway	W	12030105	3.077184622	131.803046	Low
32	Sam Rayburn Tollway	W	12030106	7.644521843	755.042587	Medium
34	SH 114 - Denton County	W	12030104	2.817034732	101.7805641	Low
38	SH 199	W	12030101	1.281860952	83.60657107	Low
38	SH 199	W	12030102	7.443138321	861.8330287	Medium
40	SH 360 Widening	W	12030102	5.690854419	254.9456917	Low
42	Southern Gateway (IH 35E/US 67)	W	12030105	14.6045695	614.5549809	Low
43	Trinity Parkway	NL	12030105	0.743254979		None
45	US 287 - Ellis County	W	12030105	0.191654881		None
45	US 287 - Ellis County	W	12030109	4.328942123	1712.402066	High
46	US 75 - North Collin County	W	12030106	7.861732812	1034.812312	Medium
47	US 75 - South Collin County	CM	12030106	7.558803223	82.64431838	Low
48	US 80	W	12030105	0.304600338		None
48	US 80	W	12030106	15.42872068	1260.892328	Medium
48	US 80	W	12030107	3.173090551	253.6710481	Low

Table A.4 Intermittent stream credit demand generated by Mobility 2040 Roadway Projects, 2017-2027

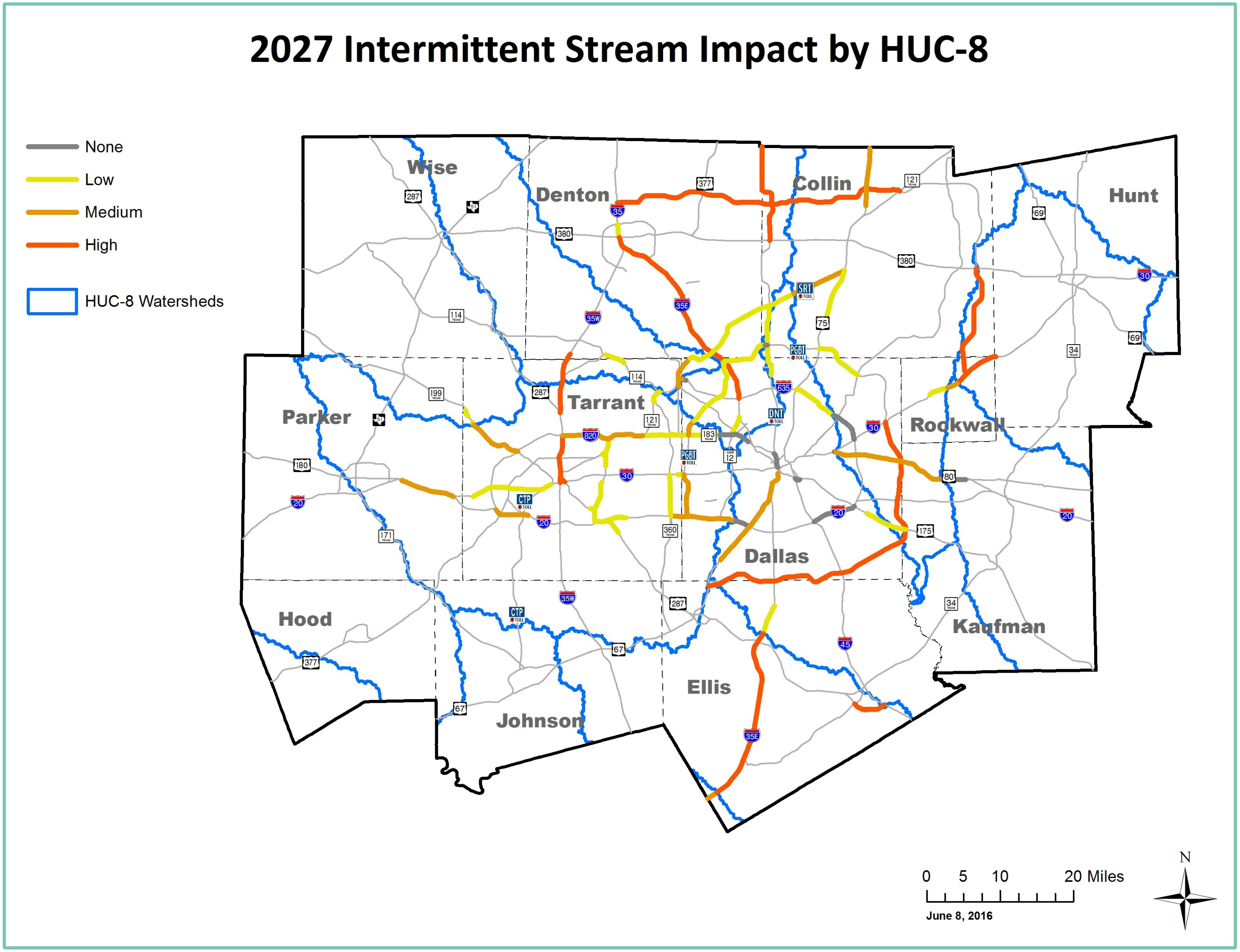


Figure A.67 Stream credit demand generated by Mobility 2040 roadway projects, 2027 intermittent stream impact by HUC-8

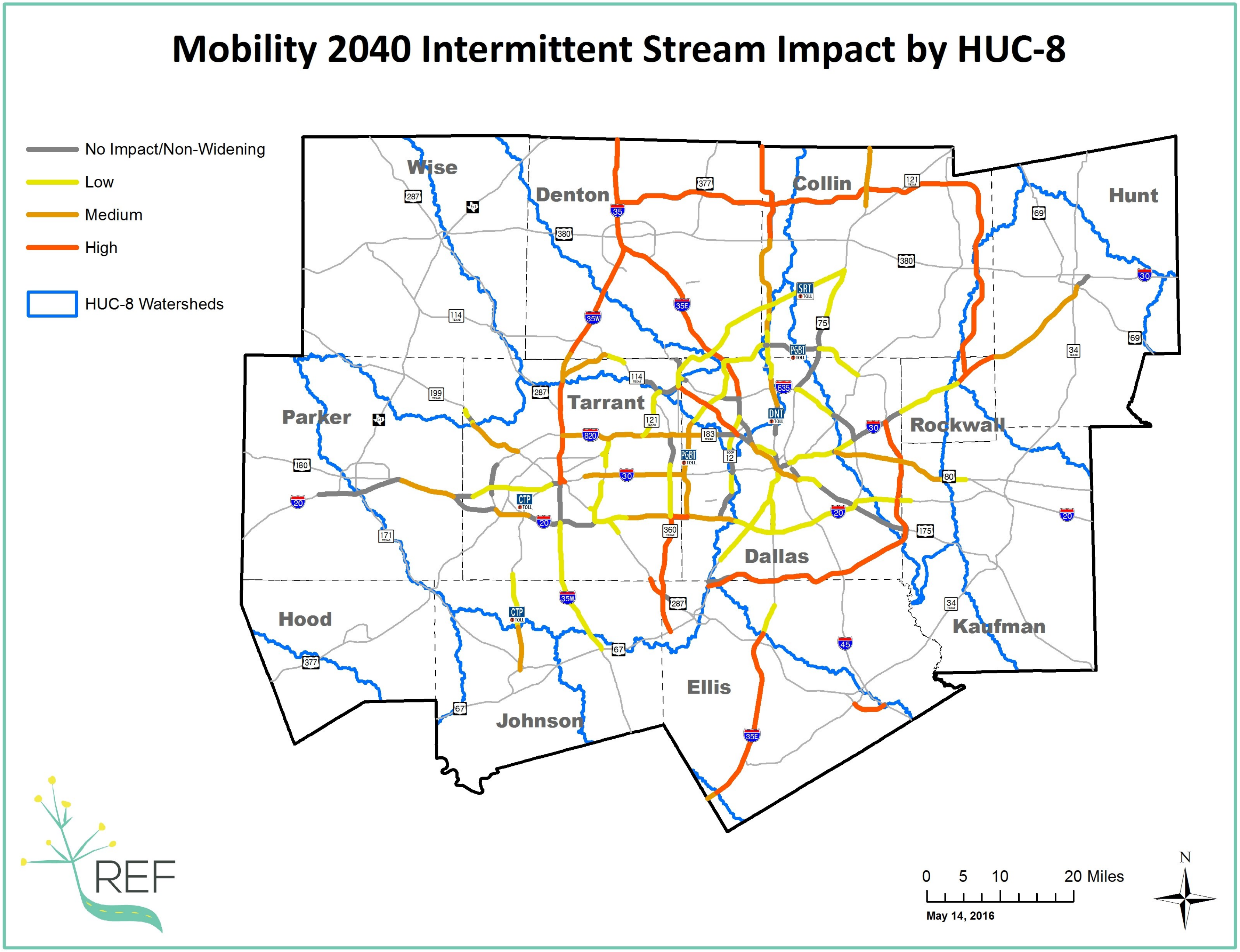


Figure A.68 Stream credit demand generated by Mobility 2040 roadway projects, Mobility 2040 intermittent stream impact by HUC-8

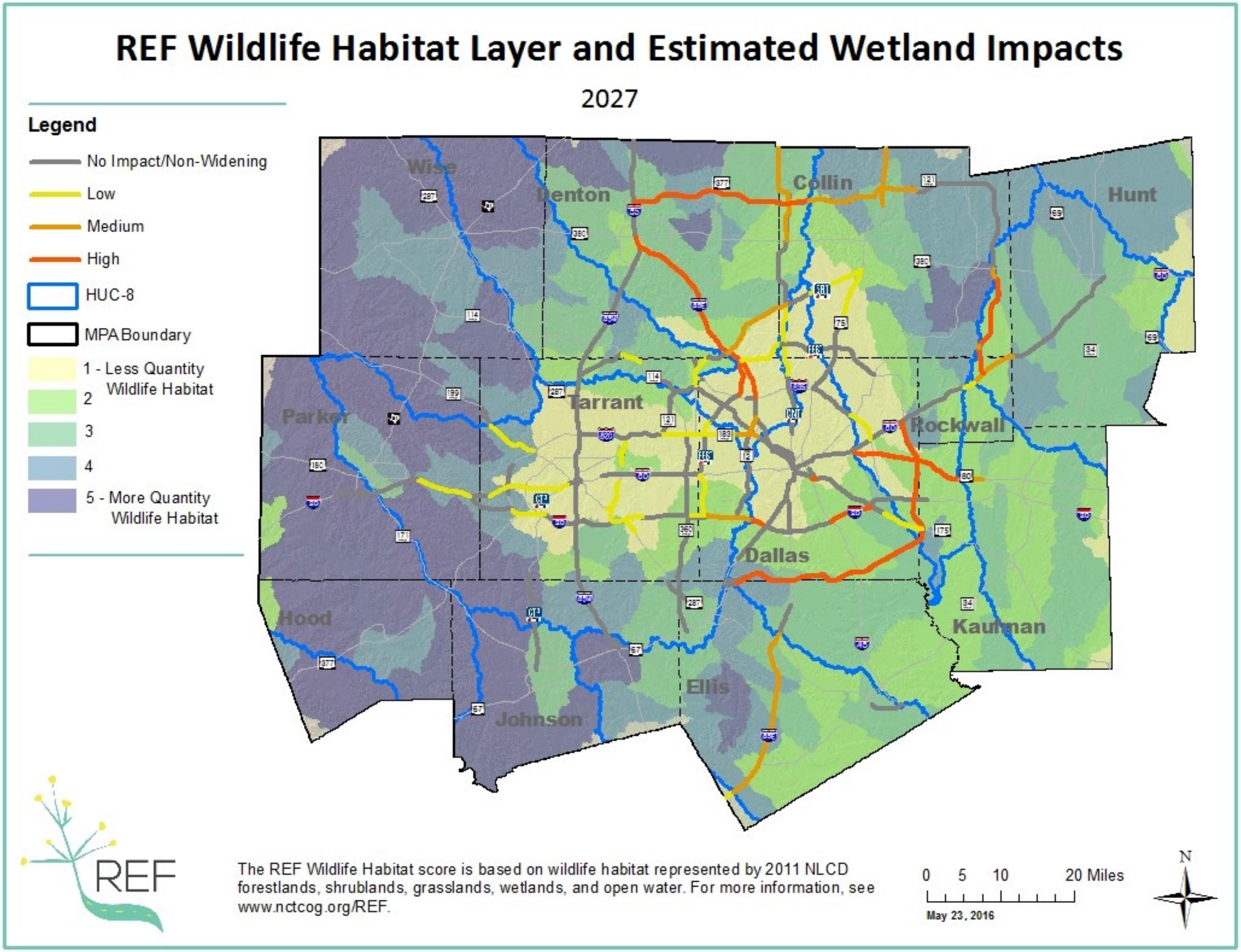


Figure A.69 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated wetland impacts, 2027

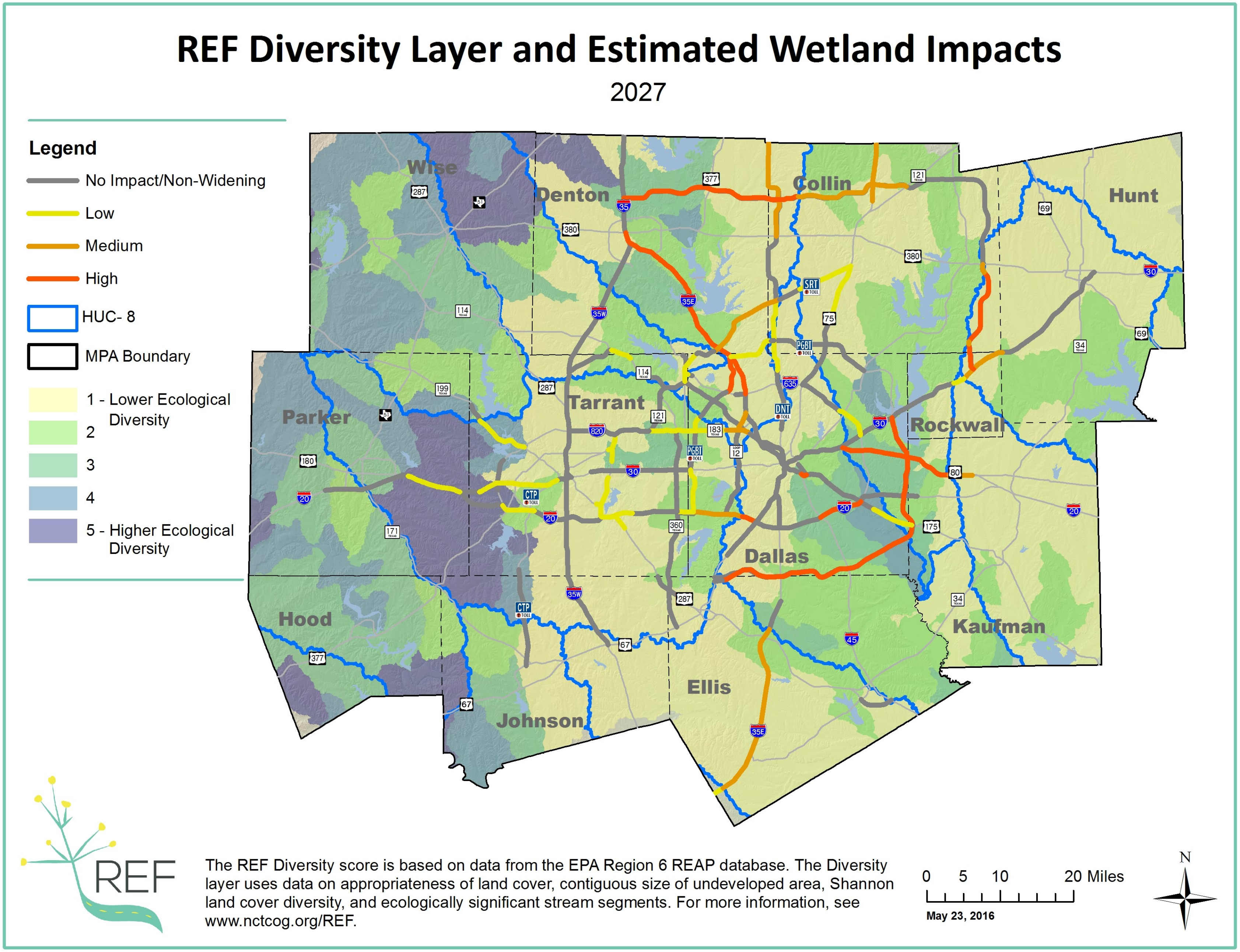


Figure A.70 Mobility 2040 impact on ecological factors, REF diversity layer and estimated wetland impacts, 2027

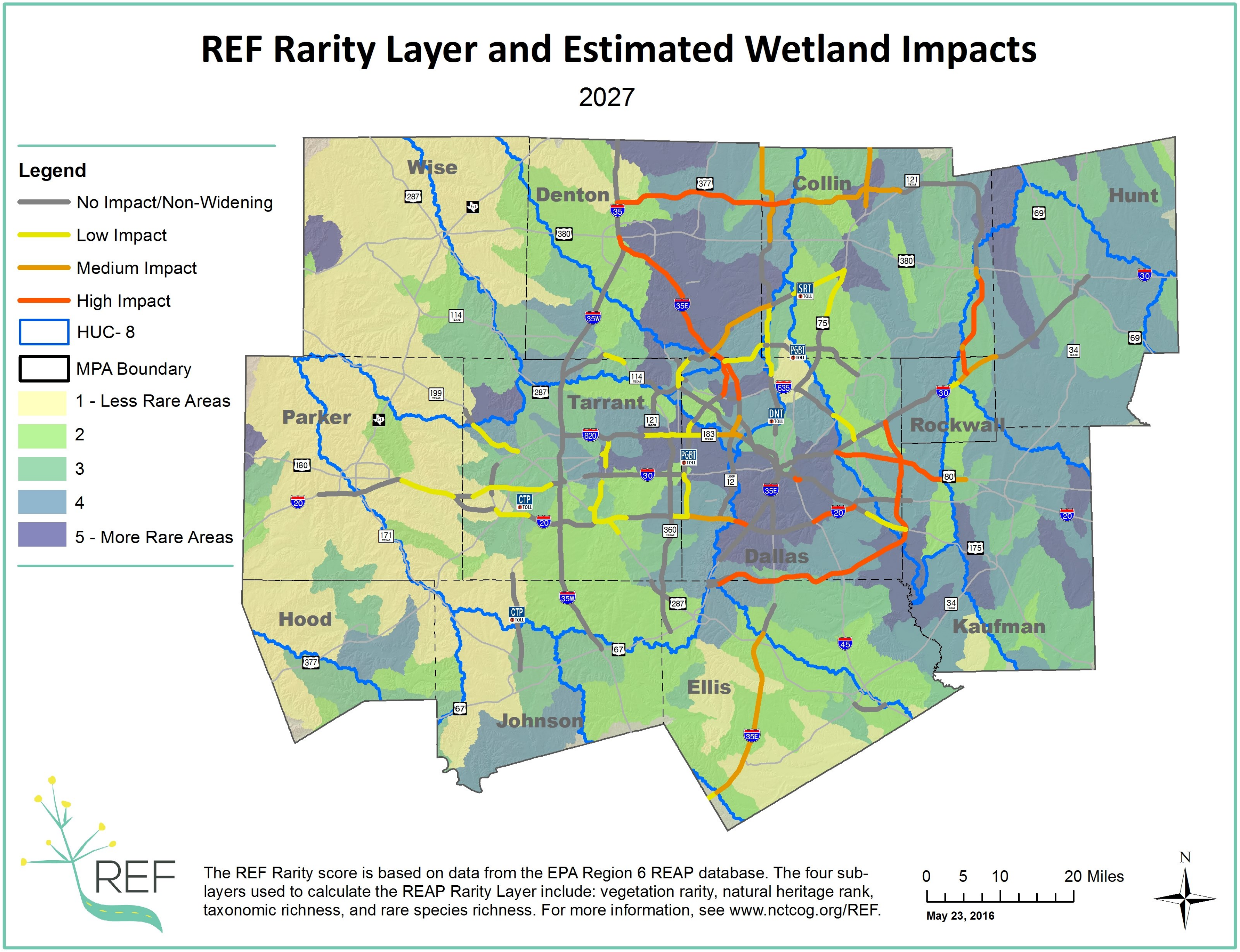


Figure A.71 Mobility 2040 impact on ecological factors, REF rarity layer and estimated wetland impacts, 2027

Mobility 2040 Impact on Ecological Factors

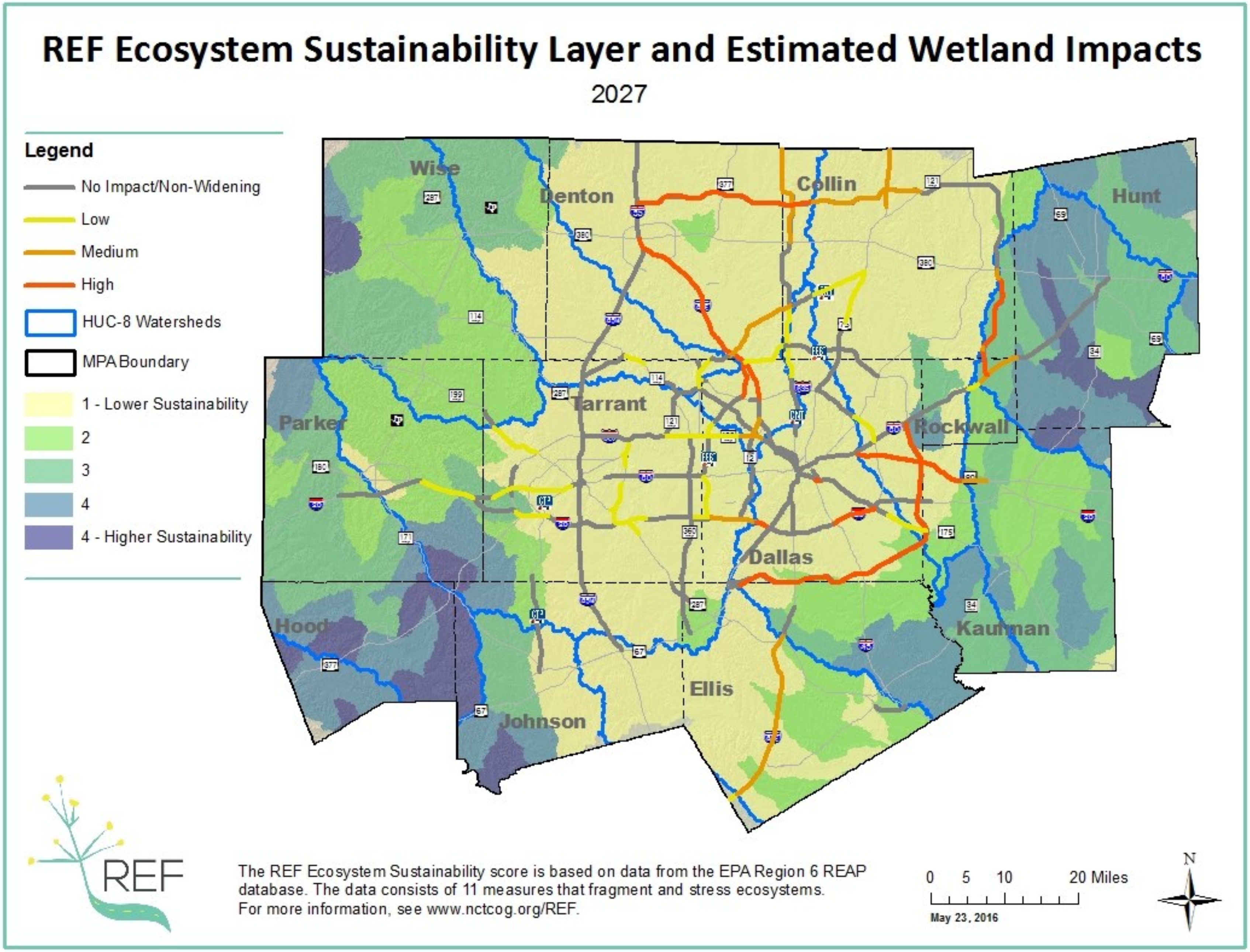


Figure A.72 Mobility 2040 impact on ecological factors, REF sustainability layer and estimated wetland impacts, 2027

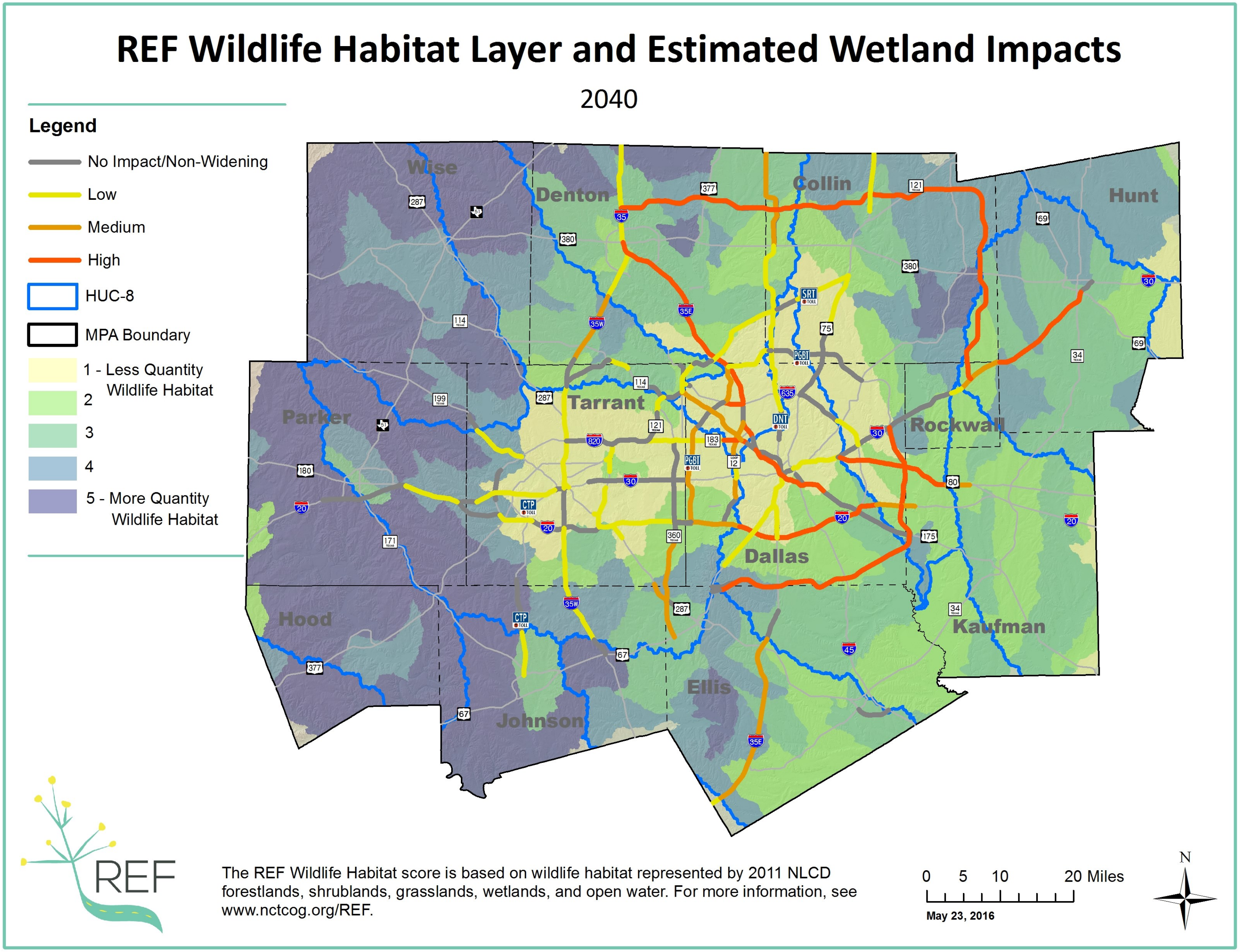


Figure A.73 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated wetland impacts, 2040

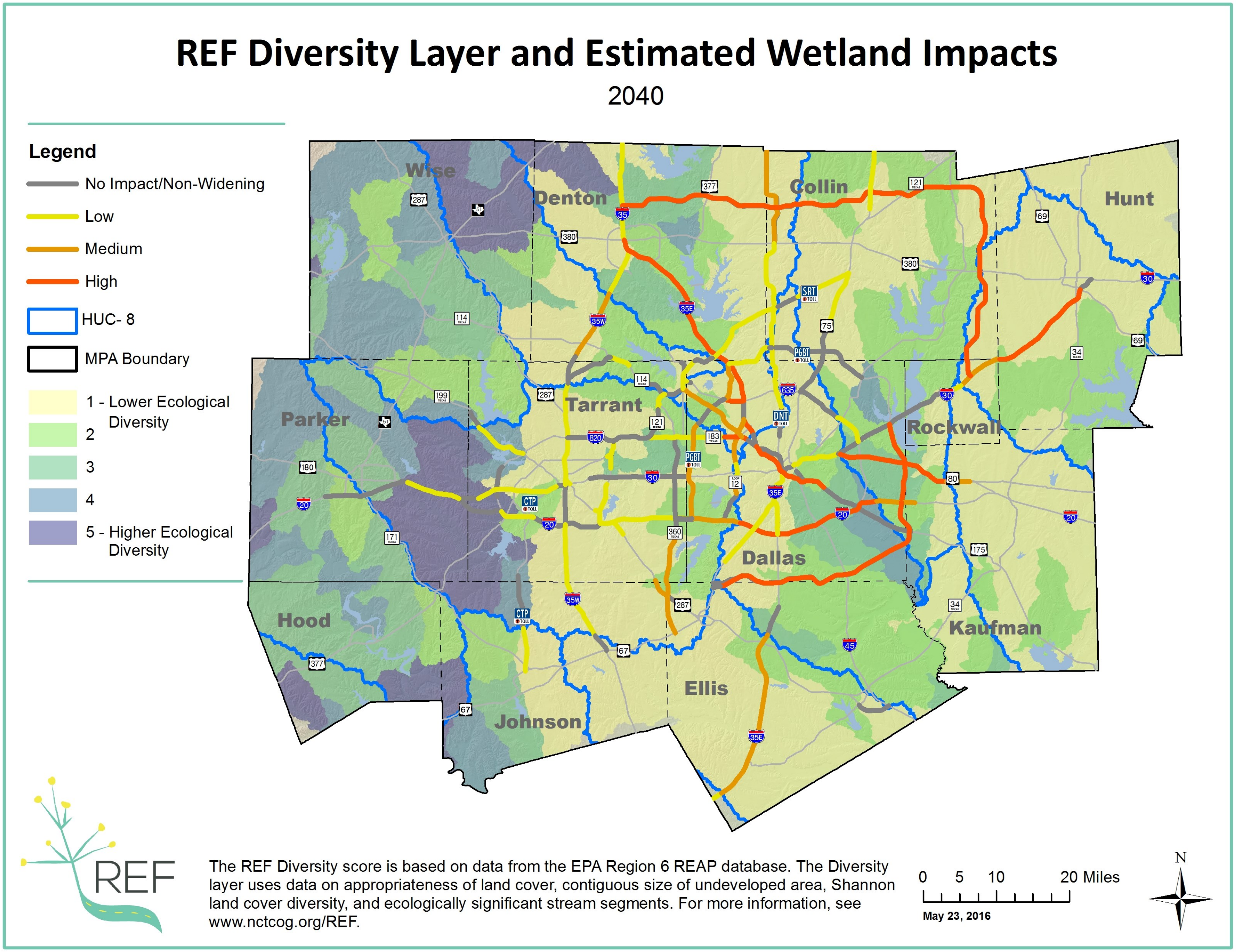


Figure A.74 Mobility 2040 impact on ecological factors, REF diversity layer and estimated wetland impacts, 2040

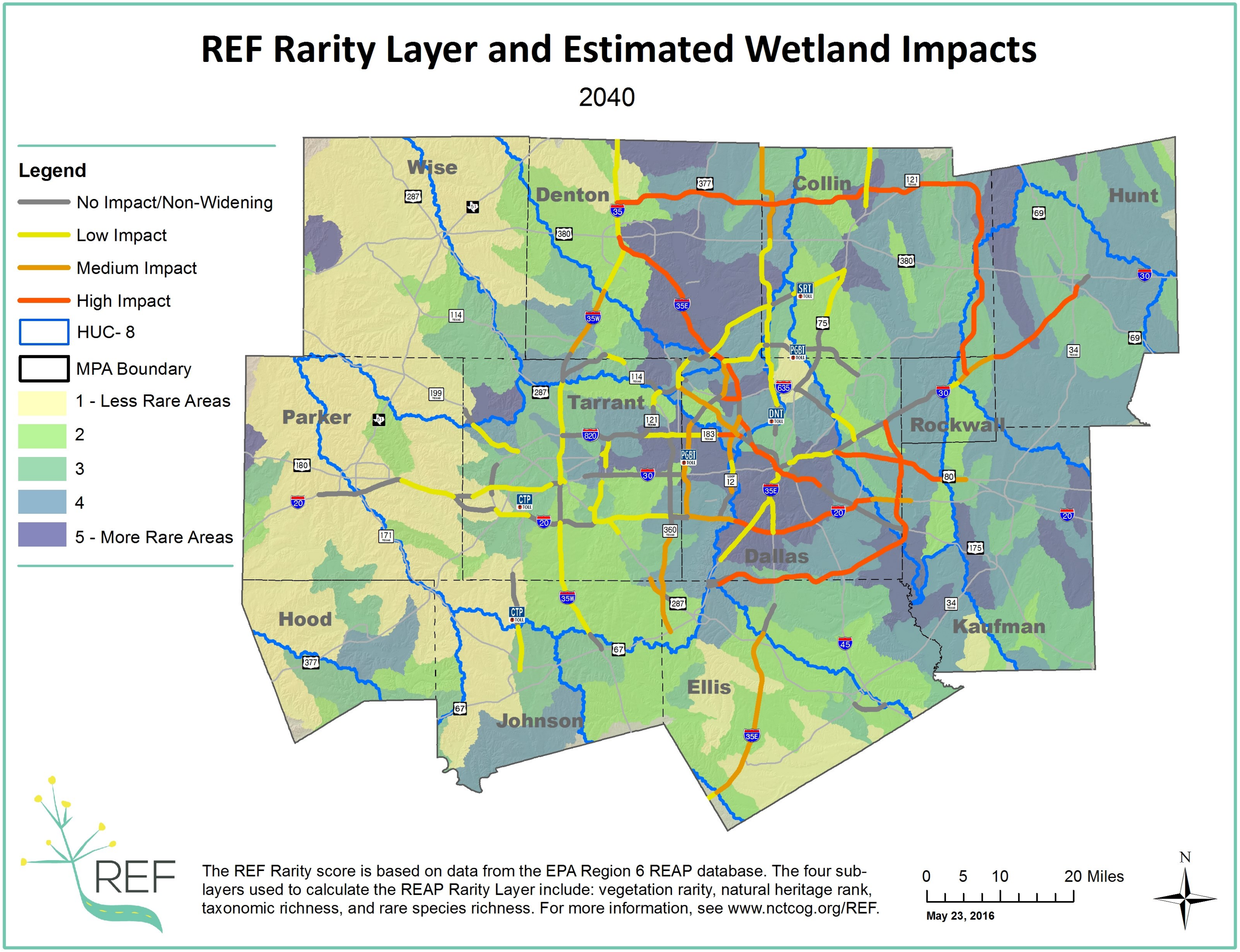


Figure A.75 Mobility 2040 impact on ecological factors, REF rarity layer and estimated wetland impacts, 2040

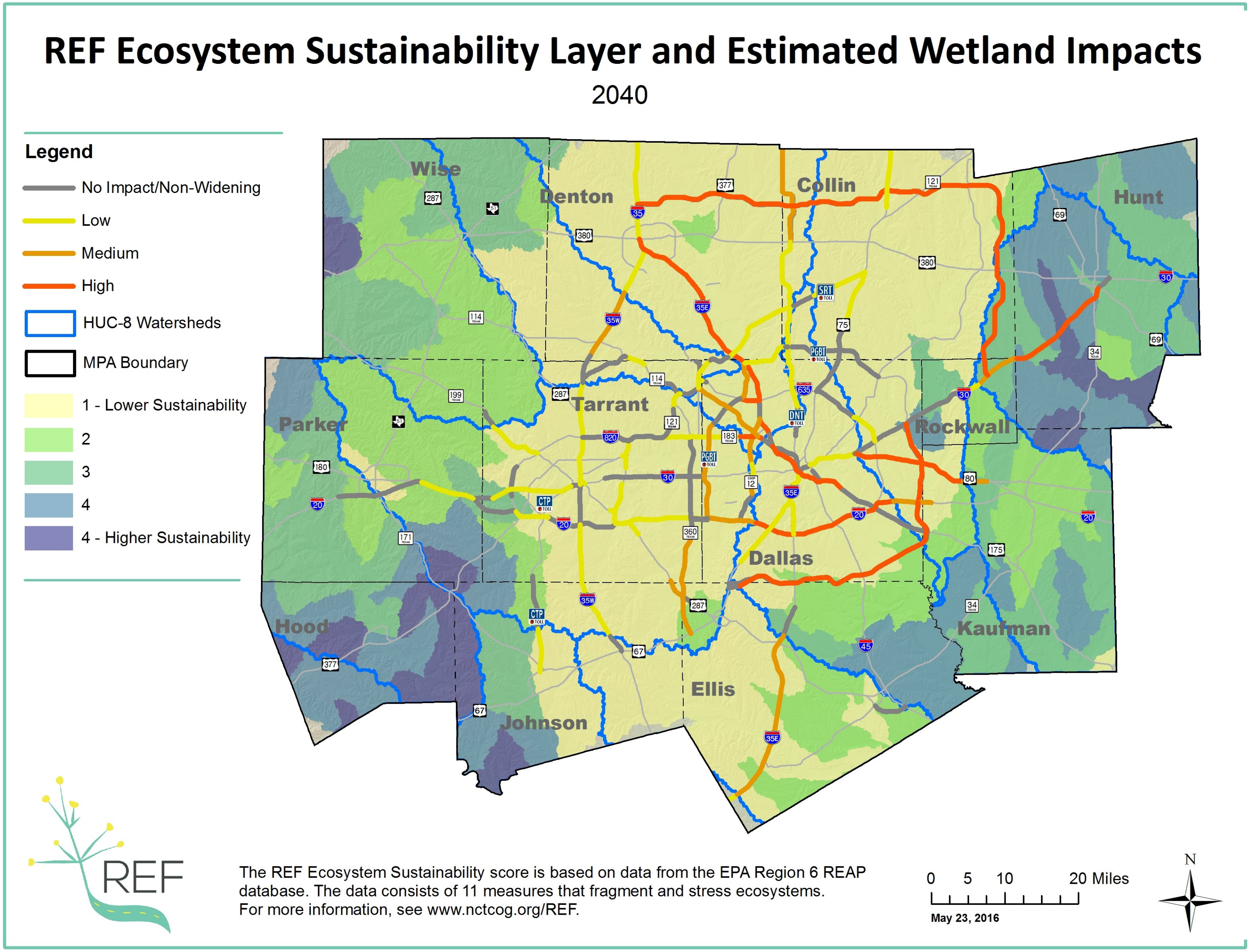


Figure A.76 Mobility 2040 impact on ecological factors, REF sustainability layer and estimated wetland impacts, 2040

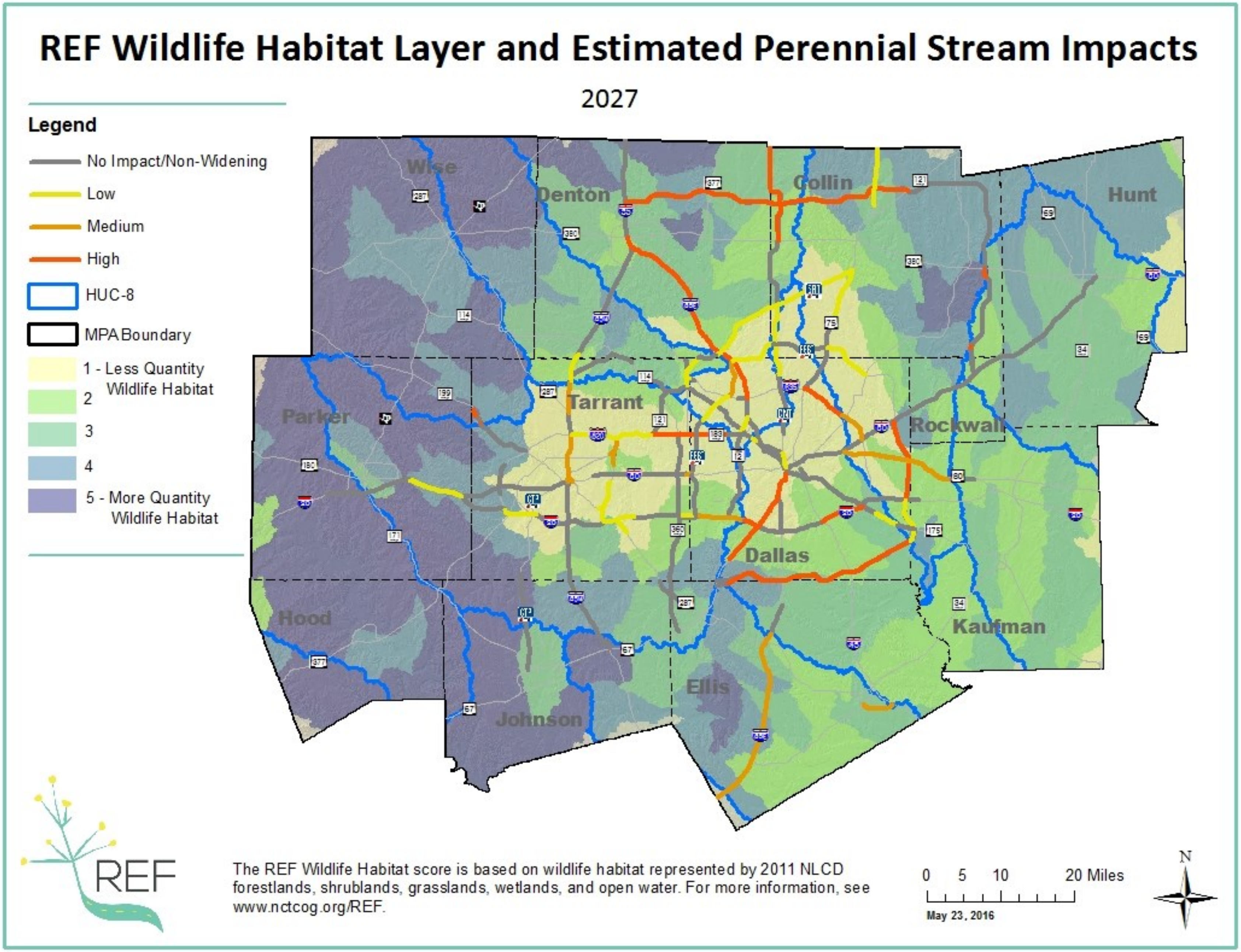


Figure A.77 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated wetland impacts, 2027

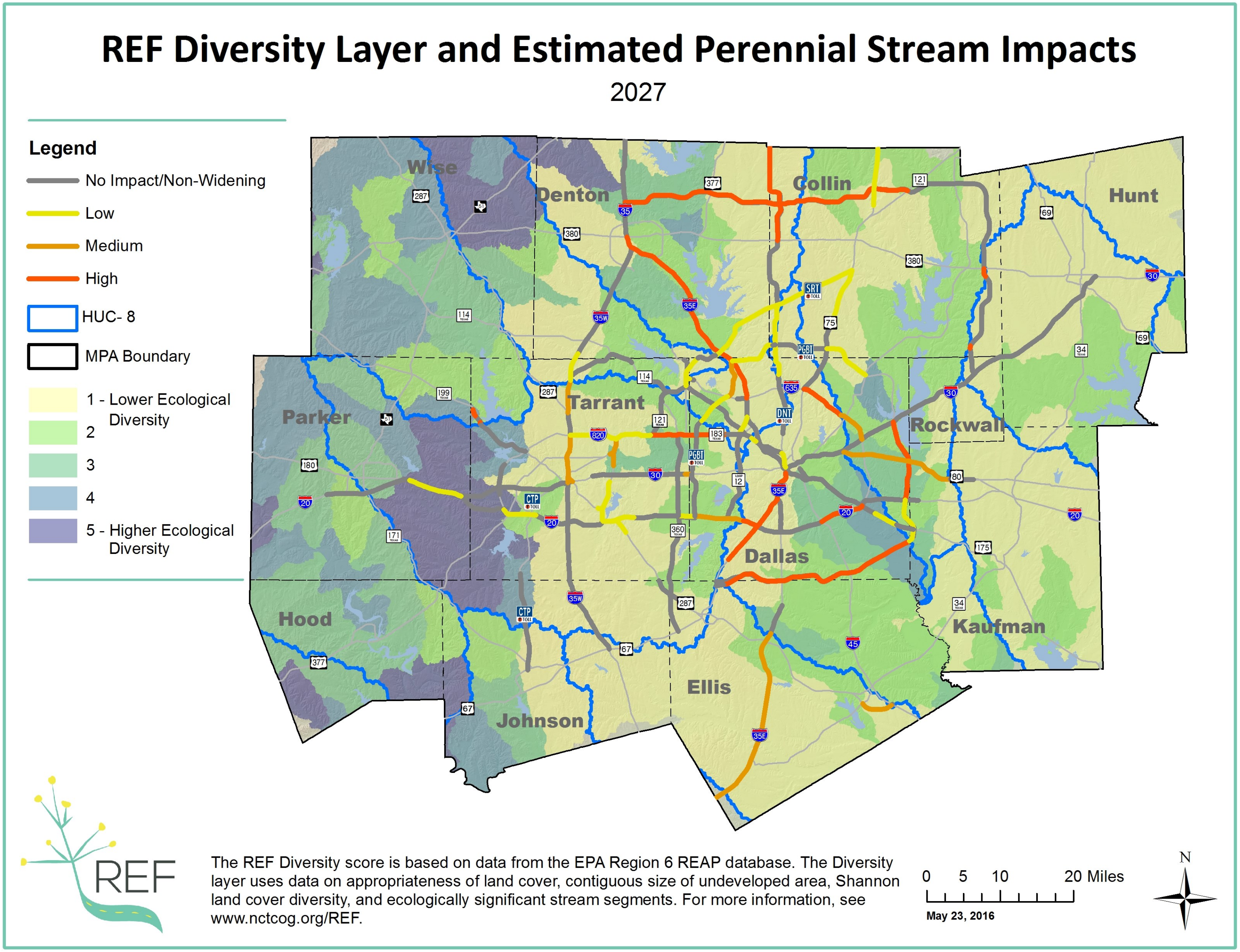


Figure A.78 Mobility 2040 impact on ecological factors, REF diversity layer and estimated wetland impacts, 2027

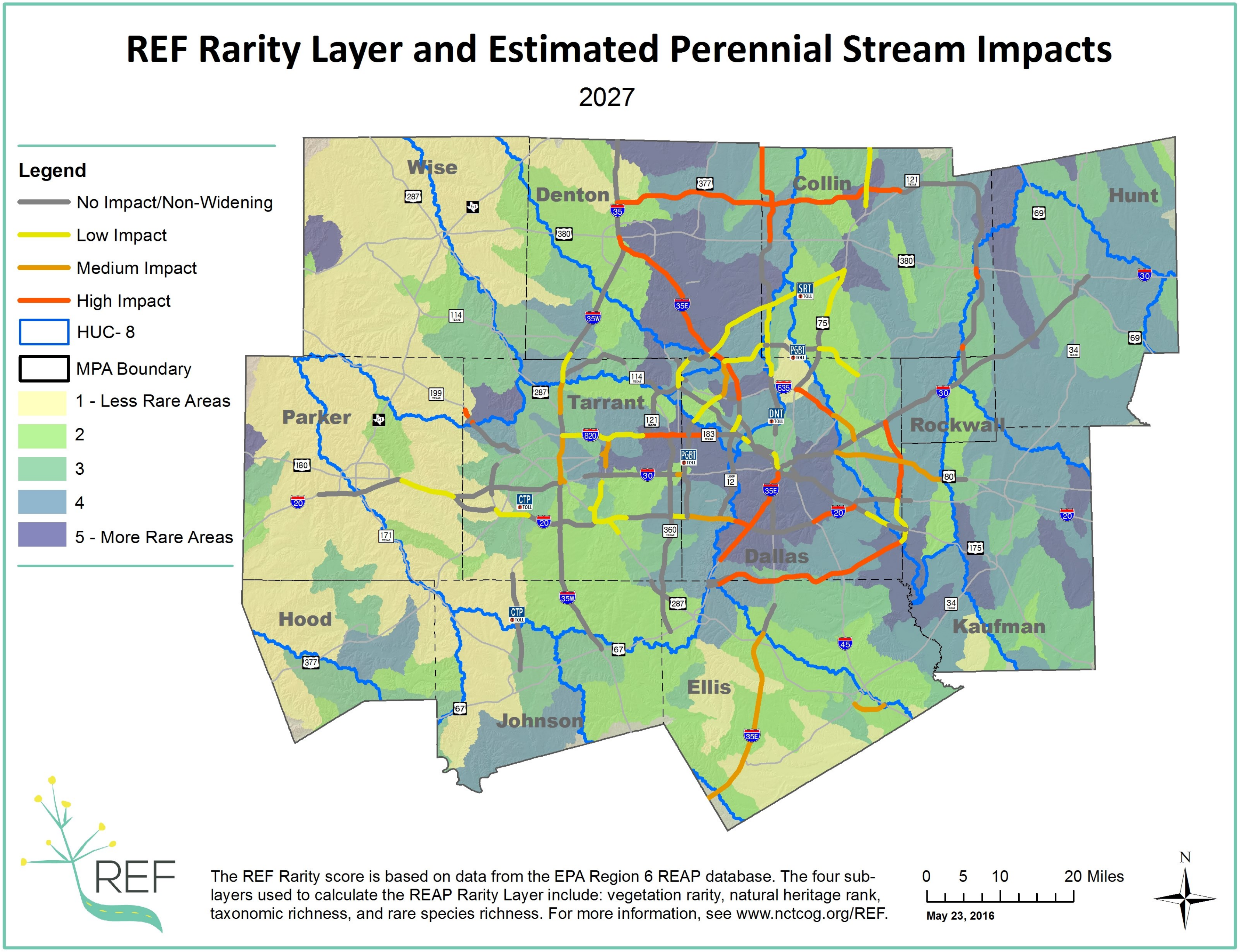


Figure A.79 Mobility 2040 impact on ecological factors, REF rarity layer and estimated wetland impacts, 2027

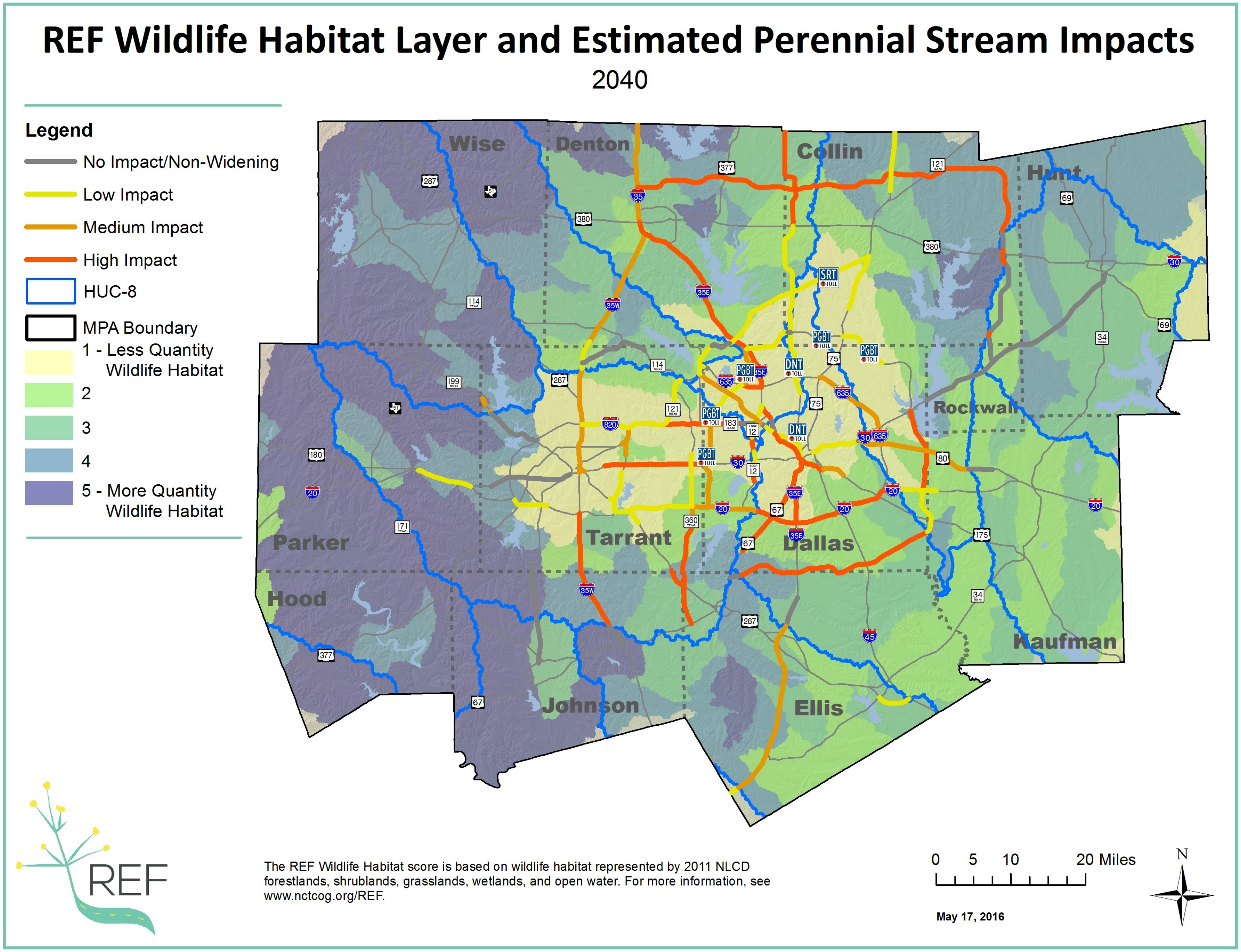


Figure A.80 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated perennial stream impacts, 2040

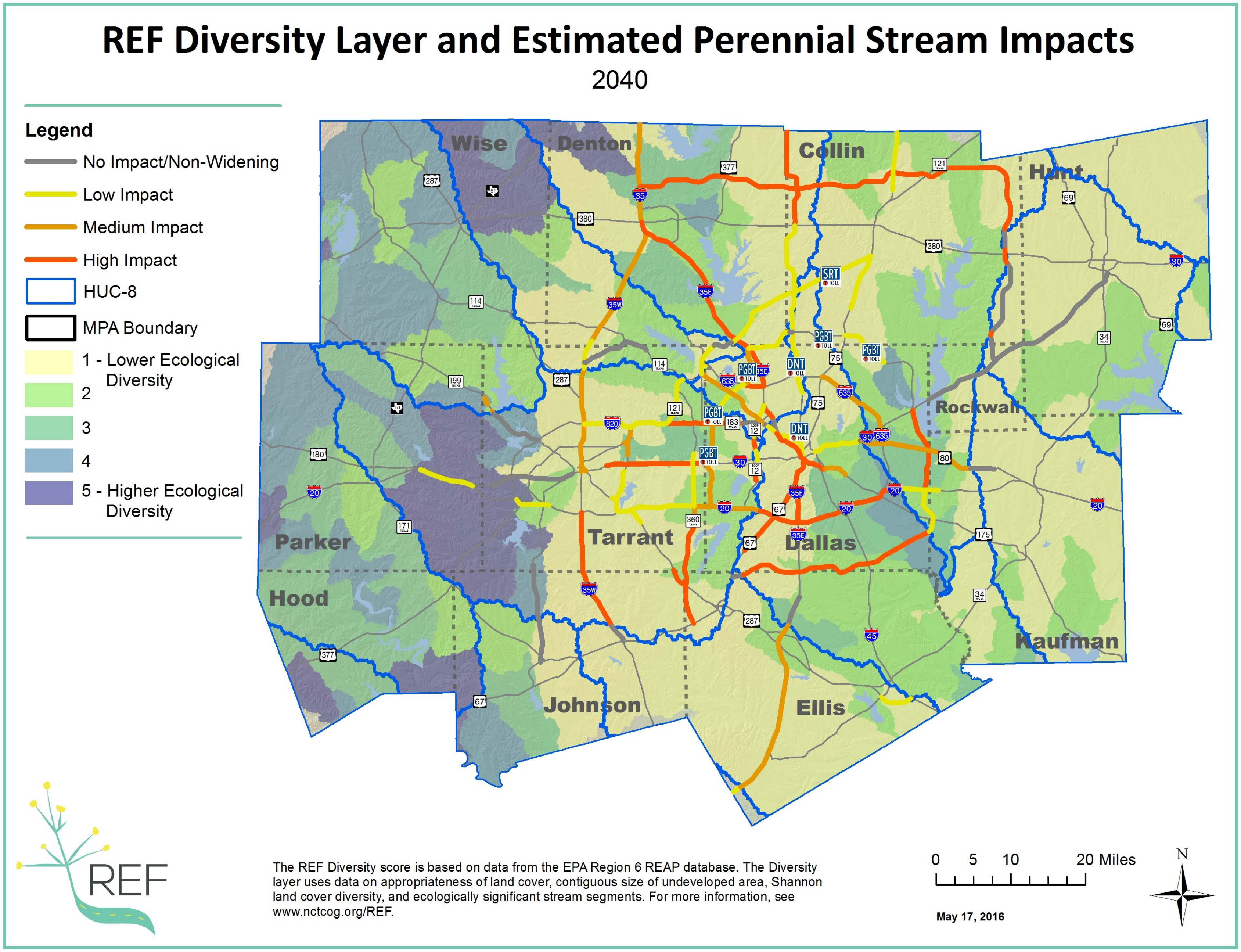


Figure A.81 Mobility 2040 impact on ecological factors, REF diversity layer and estimated perennial stream impacts, 2040

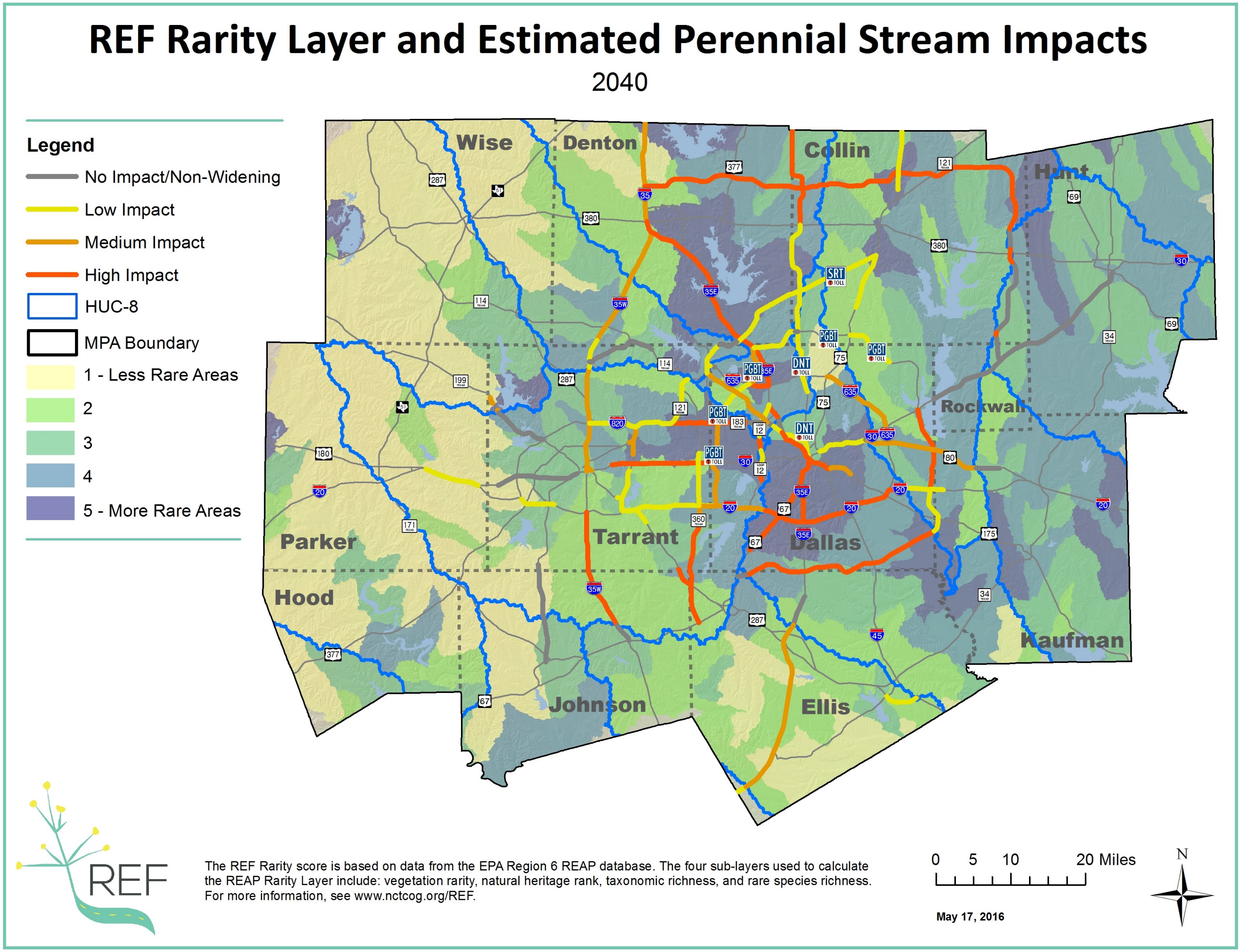


Figure A.82 Mobility 2040 impact on ecological factors, REF rarity layer and estimated perennial stream impacts, 2040

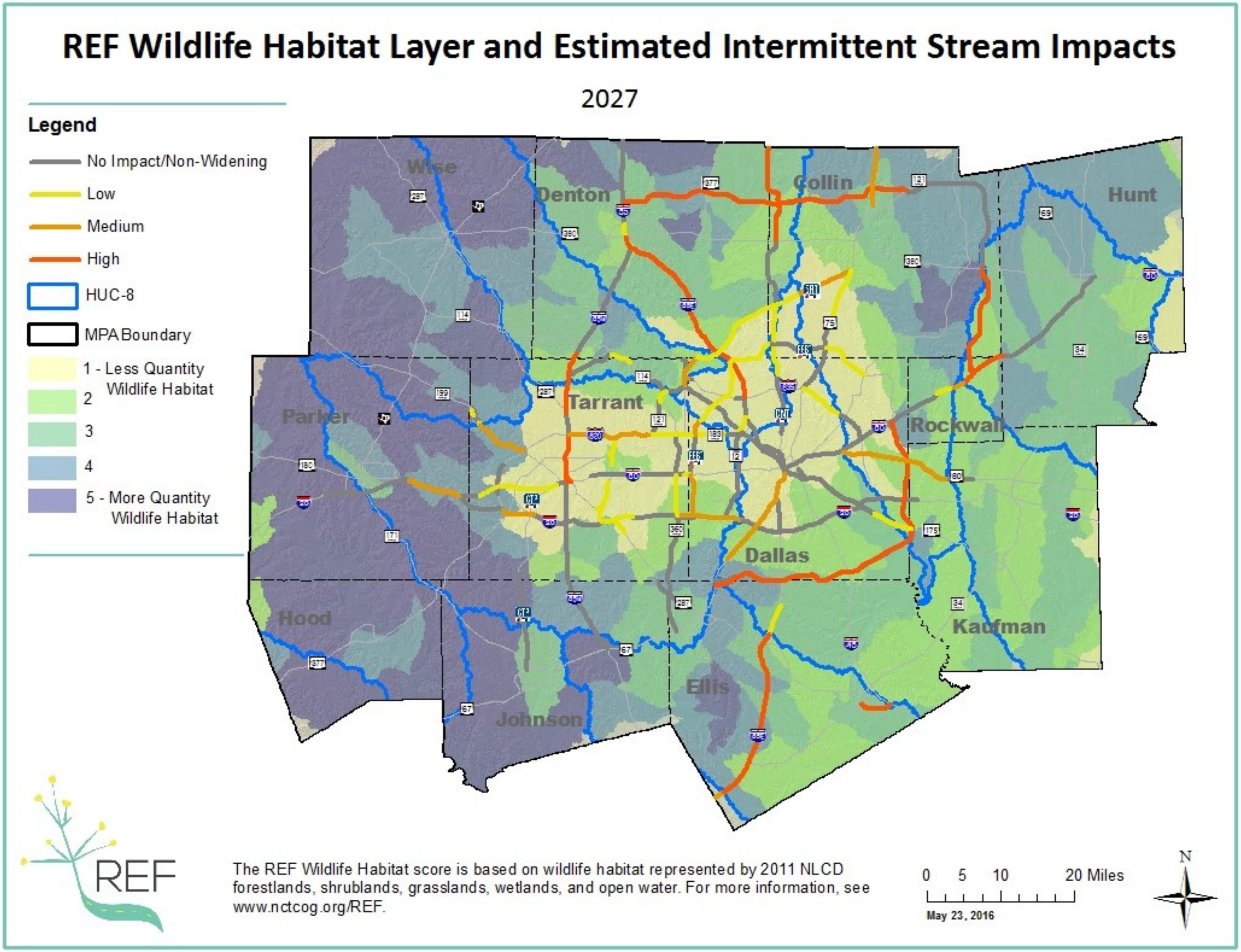


Figure A.83 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated intermittent stream impacts, 2027

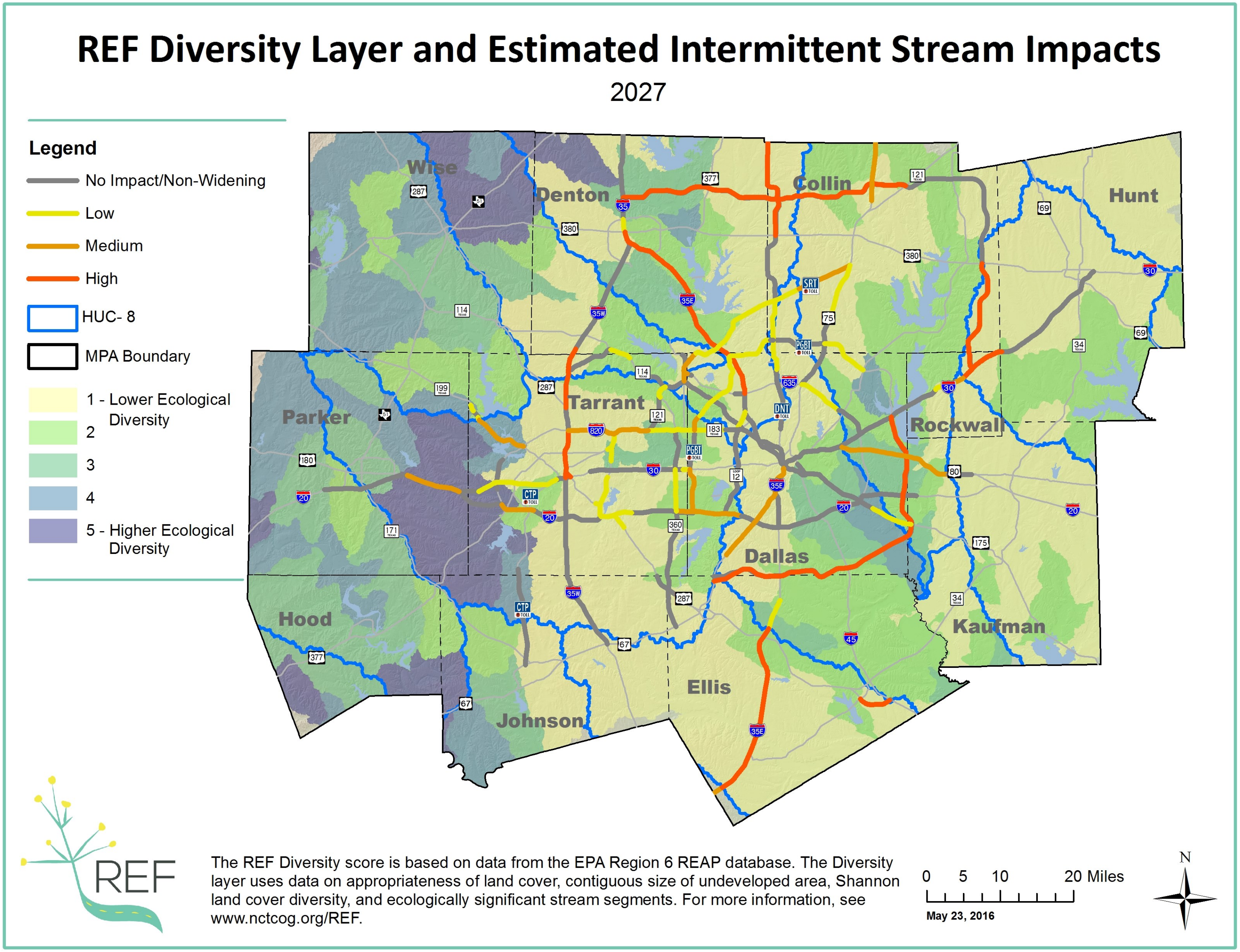


Figure A.84 Mobility 2040 impact on ecological factors, REF diversity layer and estimated intermittent stream impacts, 2027

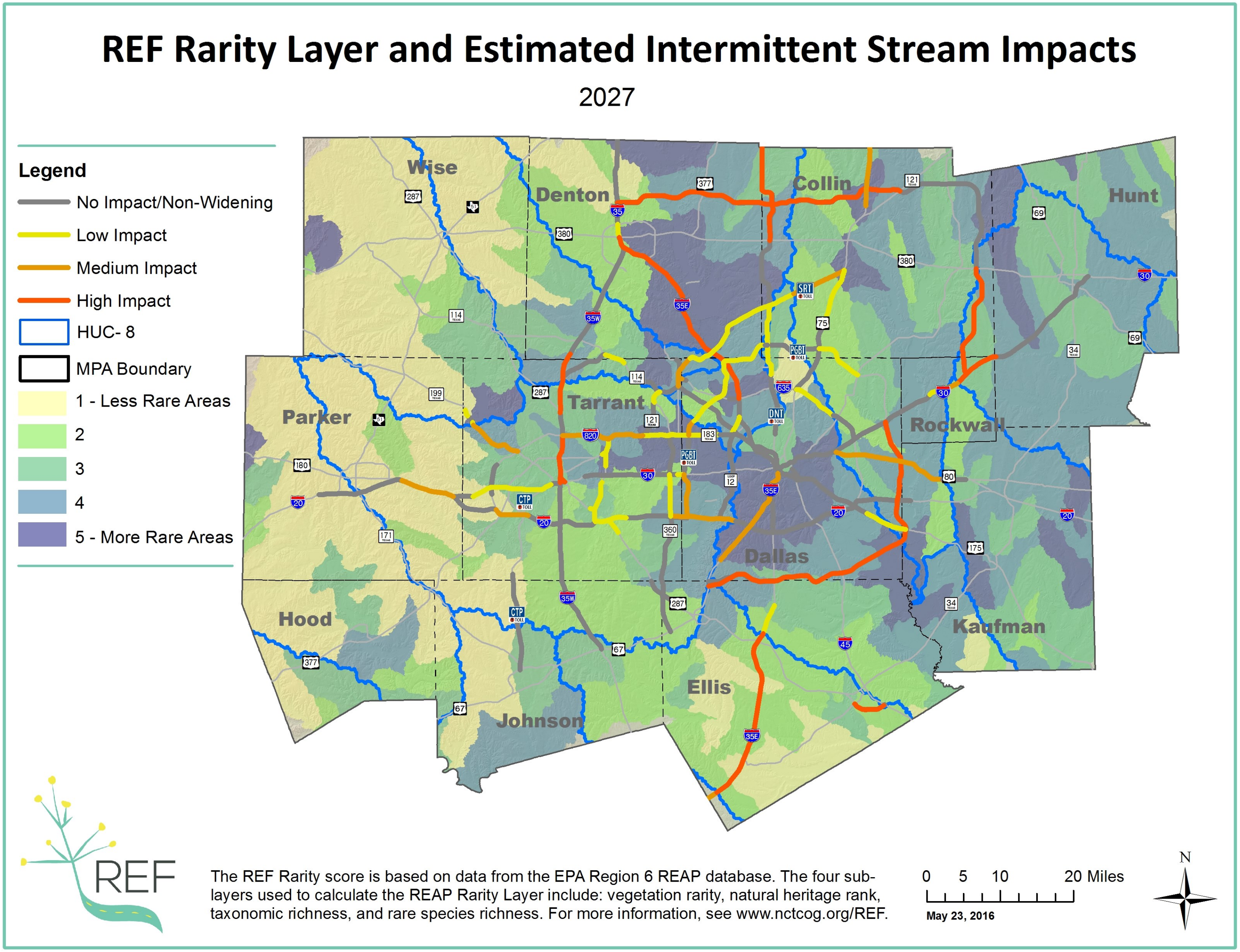


Figure A.85 Mobility 2040 impact on ecological factors, REF rarity layer and estimated intermittent stream impacts, 2027

Mobility 2040 Impact on Ecological Factors

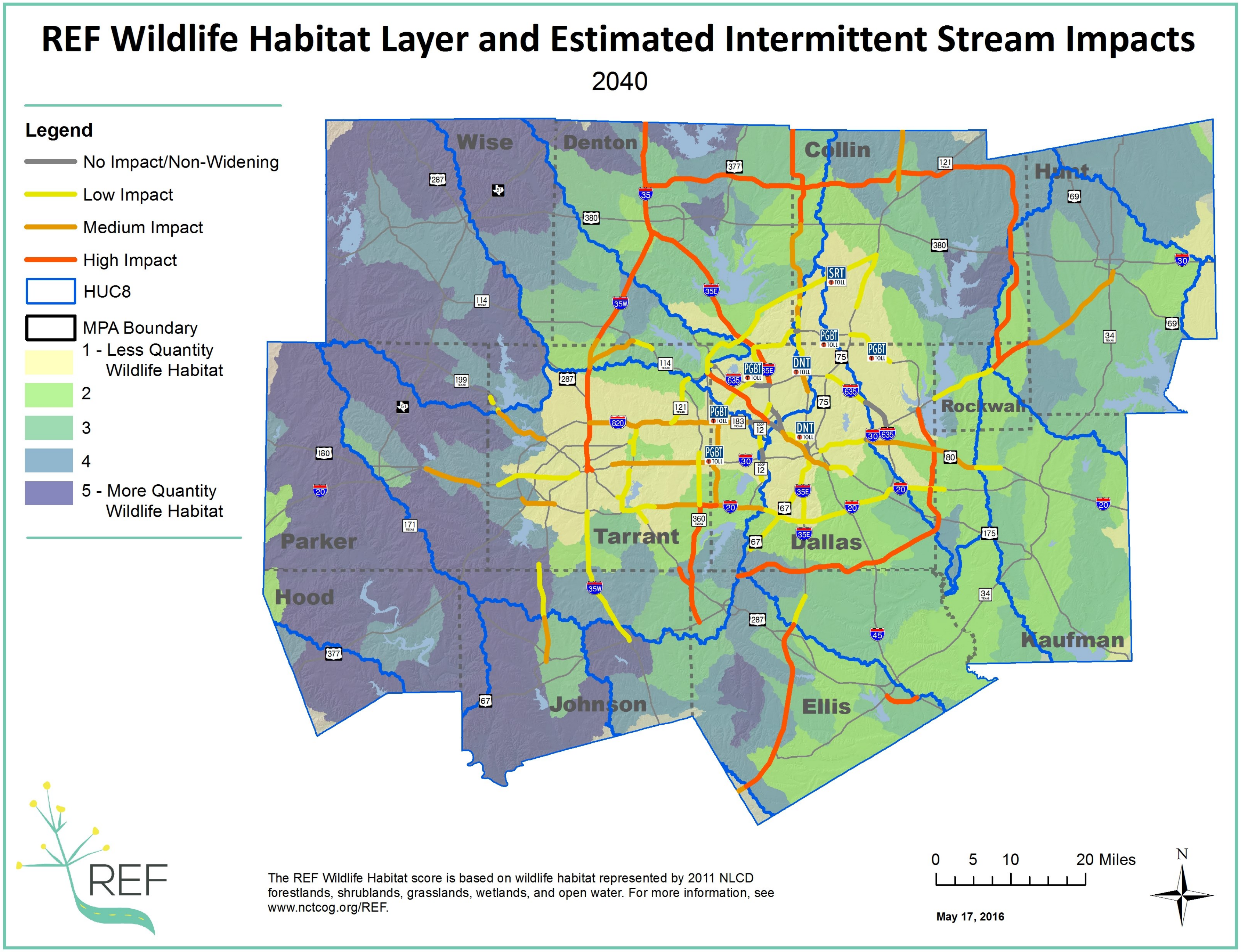


Figure A.86 Mobility 2040 impact on ecological factors, REF wildlife habitat layer and estimated intermittent stream impacts, 2040

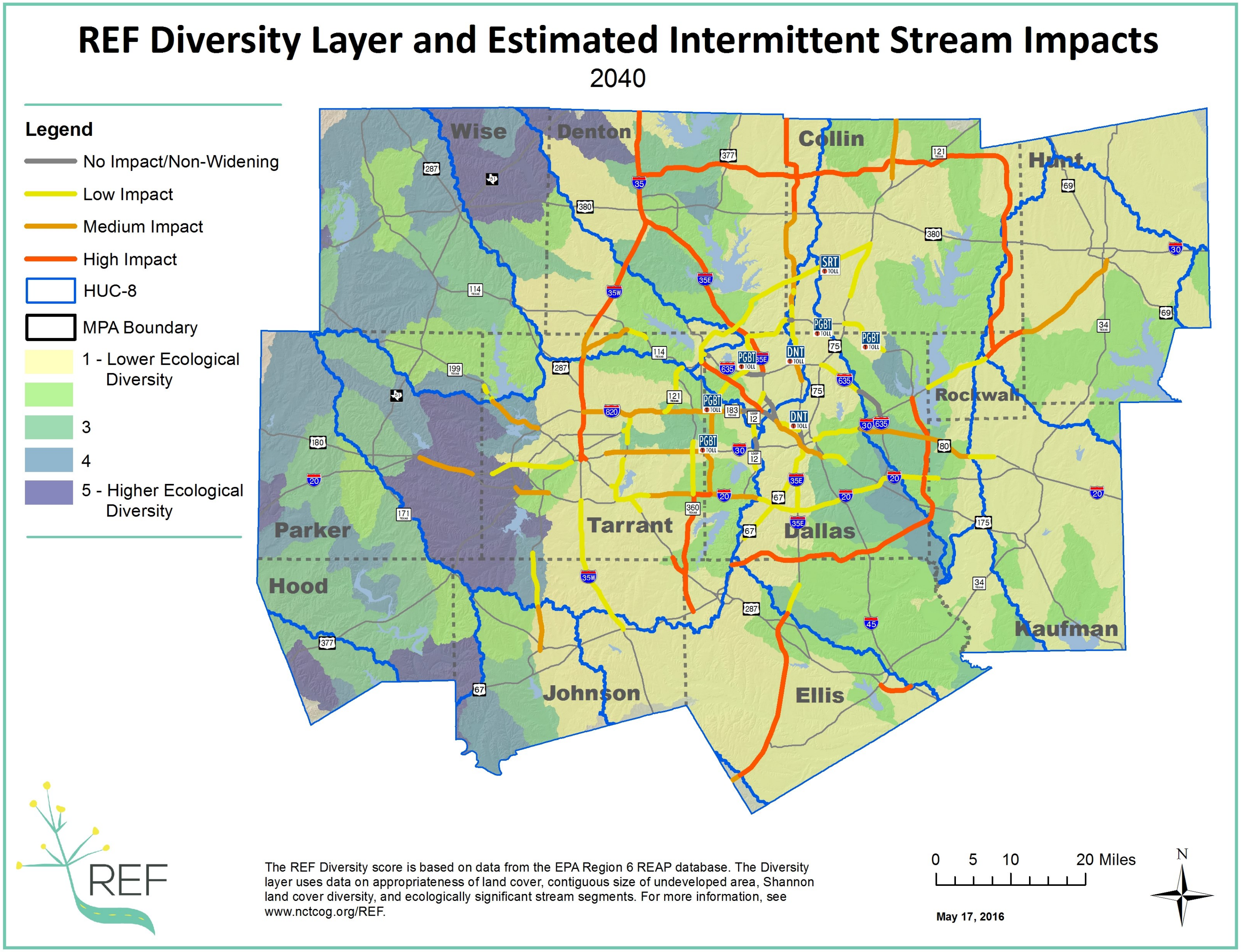


Figure A.87 Mobility 2040 impact on ecological factors, REF diversity layer and estimated intermittent stream impacts, 2040

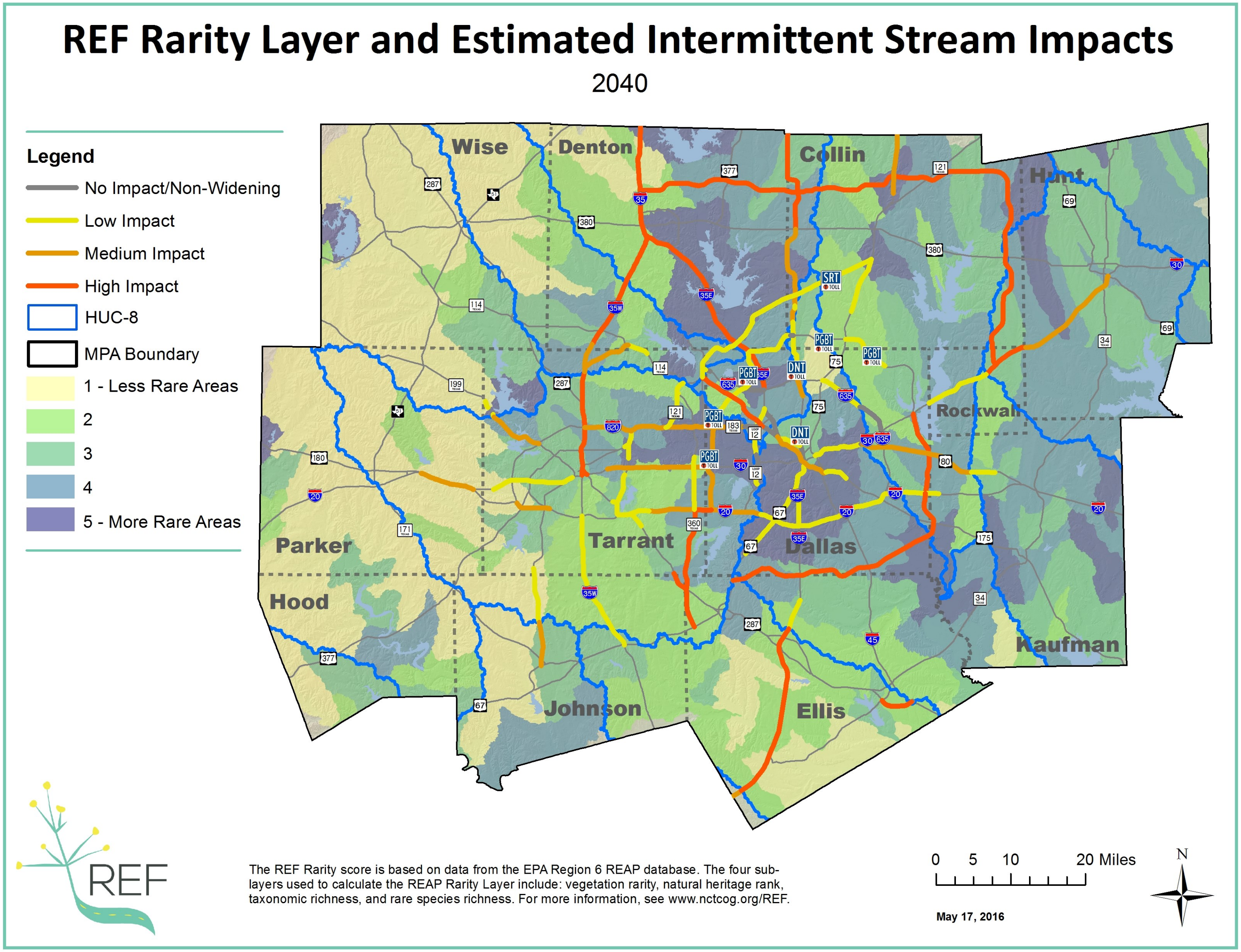


Figure A.88 Mobility 2040 impact on ecological factors, REF rarity layer and estimated intermittent stream impacts, 2040

Discussion of Project-Level Considerations

After the technical analysis was completed for the Mitigation Assessment, a project-level analysis was utilized to identify potential mitigations sites for new stream mitigation banks.

The analysis included identifying those HUC-8 areas that would serve as the primary stream mitigation for our identified projects: Loop 9, the East Branch, and the Collin County Outer Loop. These three projects crossed into four distinct HUC-8 watersheds: East Fork Trinity (12030106), Upper Trinity (12030105), Upper Sabine (12010001), and Elm Fork Trinity (12030103). A screen-line analysis was conducted to narrow down those stream segments within the HUC-8s that had received the highest scores in the Stream Enhancement analysis (scores of eight or nine).

Once the stream segments were reduced to only those of the highest rankings, a qualitative analysis was conducted for each segment by a wetland and stream specialist. Each segment was visually inspected on aerial photography to determine further ranking. Elements investigated included confirming actual presence of a natural stream, stream density in the surrounding area, and compatibility with local land use plans in the area (if available). Utilizing these criteria, potential mitigation sites were identified in each HUC-8 watershed. The following describes each area identified by this study.

Clear Creek (Elm Fork Trinity HUC-8): This site is located in northwest Denton County west of the city of Sanger. This watershed is located in a rural area most dominated by agricultural land. A small forested bottomlands area surrounds the creek, which flows into Lake Lewisville.

East Fork Trinity River (East Fork Trinity HUC-8): This site is located on the border between Dallas and Kaufman counties in the city of Mesquite. The stream flows from Lake Ray Hubbard from the north and fills a large bottomland forest with multiple smaller stream segments feeding into the river. Residential development and agricultural lands are located on the west side while undeveloped land is located to the east.

Old Tenmile Creek (Upper Trinity HUC-8): Located on the border between northeast Ellis County and southwest Kaufman County and near the Village of Rosser. Old Tenmile Creek is a larger tributary to East Fork Trinity River. A narrow bottomland forest is associated with the creek before its confluence with the East Fork Trinity River. The land within the area is dominated by agricultural and undeveloped properties.

Cowleech Fork Sabine River (Upper Sabine HUC-8): Located in the central southeast area of Hunt County and southeast of the city of Greenville, Cowleech Fork Sabine River serves as a direct tributary to Lake Tawakoni as one of three major "branches" of the lake. This location has a large number of tributaries that feed into the creek and other adjacent watersheds that feed into the lake. Small rural residential, agricultural land, and undeveloped land occupy the surrounding area.

Banks that Serve New Location Corridors

New Location Corridors	Project Length	Mitigation Banks That Serve Project Locations	Service Area	Type of Credits at Bank
East Branch	11.36 miles	Big Woods on the Trinity	Primary	Wetland Only
		Bunker Sands	Primary	Wetland Only
		South Forks Trinity River	Primary	Wetland and Legacy Stream Credits
		South Forks Trinity River Ten Mile Tract	Primary	Wetland and Legacy Stream Credits
		Trinity River	Primary	Wetland and Legacy Stream Credits
		Red Oak Umbrella	Secondary	Wetland and Legacy Stream Credits
		Mill Branch	Tertiary	Intermittent and Ephemeral Streams
Loop 9	34.91 miles	Big Woods on the Trinity	Primary	Wetland Only
		Bunker Sands	Primary	Wetland Only
		South Forks Trinity River	Primary	Wetland and Legacy Stream Credits
		South Forks Trinity River Ten Mile Tract	Primary	Wetland and Legacy Stream Credits
		Trinity River	Primary	Wetland and Legacy Stream Credits
		Red Oak Umbrella	Secondary	Wetland and Legacy Stream Credits
		Rockin' K on Chambers Creek	Secondary	Wetland and Stream Credits
		Mill Branch	Tertiary	Intermittent and Ephemeral Streams
Outer Loop	78.09 miles	Big Woods on the Trinity	Primary	Wetland Only
		Bunker Sands	Primary	Wetland Only
		Daisy Mitigation Bank	Primary	Wetland and Perennial Stream
		Keystone	Primary	Wetland Only
		KLAMM	Primary	Wetland Only
		Mill Branch	Primary	Intermittent and Ephemeral Streams
		South Forks Trinity River	Primary	Wetland and Legacy Stream Credits
		South Forks Trinity River Ten Mile Tract	Primary	Wetland and Legacy Stream Credits
		Trinity River	Primary	Wetland and Legacy Stream Credits
		Bunker Sands	Secondary	Wetland Only
		Red Oak Umbrella	Secondary	Wetland and Legacy Stream Credits
		South Forks Trinity River	Secondary	Wetland and Legacy Stream Credits
		Trinity River	Secondary	Wetland and Legacy Stream Credits
		Mill Branch	Tertiary	Intermittent and Ephemeral Streams
		Red Oak Umbrella	Tertiary	Wetland and Legacy Stream Credits

Table A.5 Credit Ratios for Banks that Serve New Location Corridors

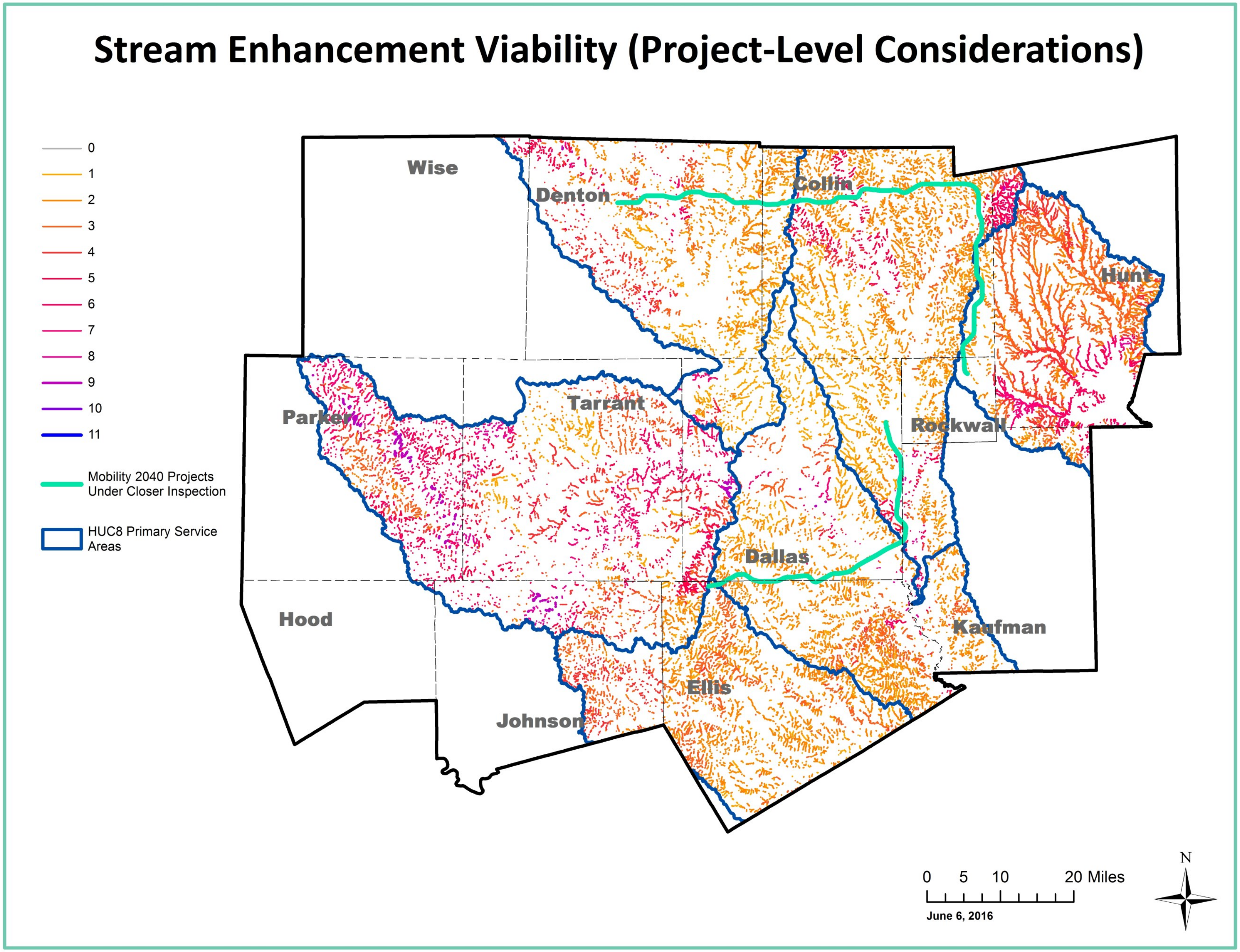


Figure A.89 Potential mitigation site identification for new roadways, stream enhancement viability (project-level considerations)

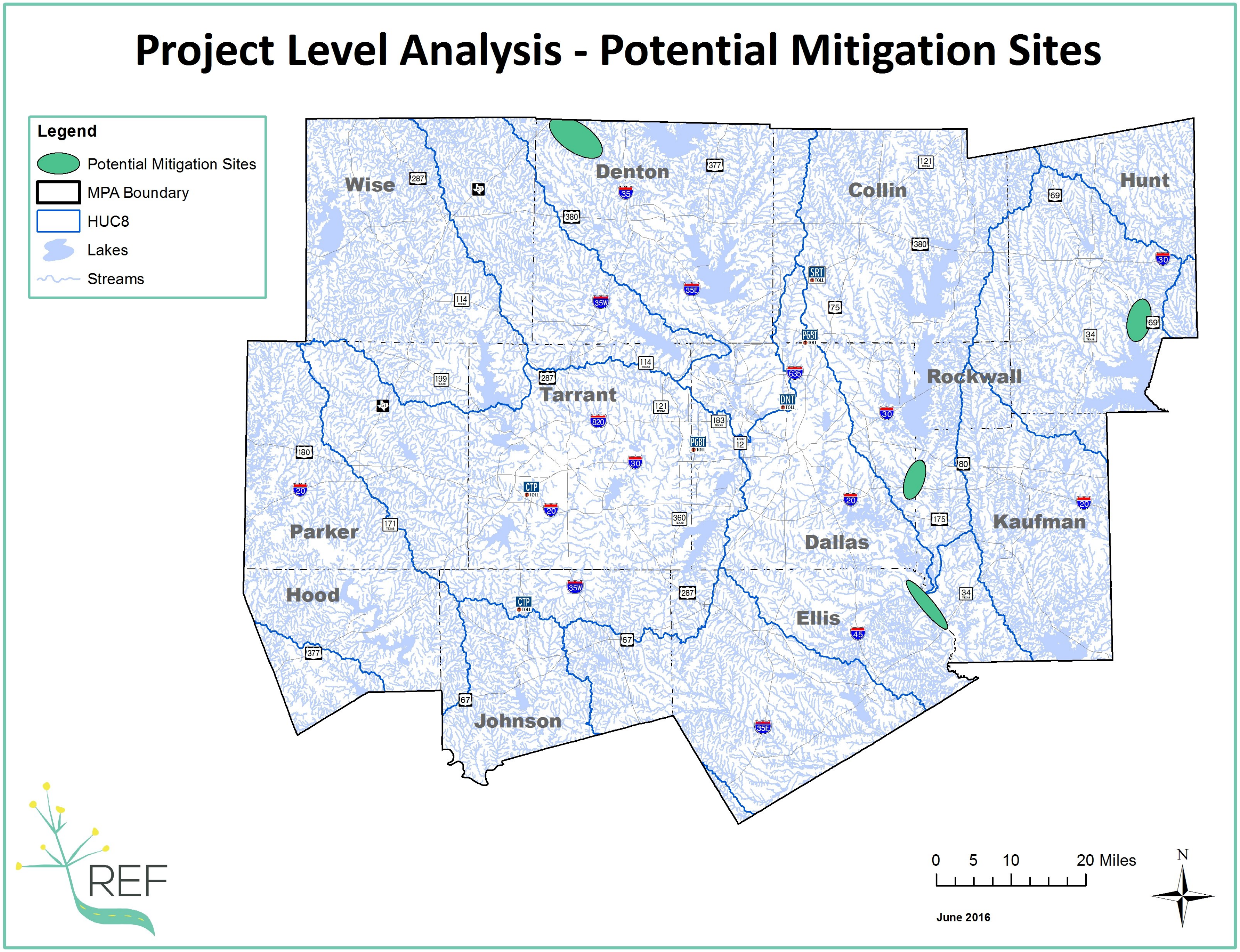


Figure A.90 Final potential mitigation site identification for stream enhancement

Appendix B – Mitigation Assessment Methods

Table of Contents

Tables and Figures

Quantifying Supply of Wetland and Stream Mitigation Credits

The Regulatory In-Lieu Fee and Bank Information Tracking System (RIBITS) database was used to identify mitigation banks that serve the Dallas-Fort Worth region. These banks' credit ledgers were downloaded and the available credits were quantified and graphed for:

- Wetlands
- Ephemeral streams, intermittent streams, perennial streams, general streams, and open water
- The number of banks with wetland and stream credits available to the Metropolitan Planning Area (MPA)

This information identified trends in credit supply. For example, the number of banks with credits available to the MPA has increased over time as has the number of credits available.

Quantifying Demand for Wetland and Stream Mitigation Credits

Using data from banks' credit ledgers, past credit purchases were categorized by year and by the following industries:

- Oil & Gas
- Transportation
- Government
- Retail/Business
- Water
- Real Estate
- Other

These data were used to graph wetland and stream credits purchased by year and industry. The data also were used to identify the industries that purchased the greatest number of credits and those whose credit purchases have increased in recent years.

Credit ledger data also were used to compare the average credit purchase for wetland credits versus the average credit purchase for stream credits.

Mapping Available Wetland and Stream Mitigation Credits

Maps were made showing available credits based on combined primary, secondary, and tertiary service areas and by primary service areas alone. All service areas used were downloaded as Keyhole Markup Language (KML) files from the RIBITS database.

In the U.S. Army Corps of Engineers (USACE) Fort Worth District, primary service areas include the entire HUC-8 in which the mitigation bank is located. Secondary service areas are restricted to the portion of a HUC-8 that is both adjacent to the HUC-8 where the bank is located and falls within the same Level III ecoregion as the bank. Tertiary service areas are restricted to the portion of a HUC-8 that is adjacent to the primary service area and falls in a different Level III ecoregion as the bank; however, this different ecoregion must be one that is adjacent to the ecoregion of the mitigation bank (USACE Fort Worth District, n.d.). Because the MPA contains three Level III ecoregions, most HUC-8s in the MPA had to be divided into two portions, and available credits were assigned taking ecoregions into consideration. Both secondary and tertiary service areas exclude any HUC-8 that falls in a different major river basin from the primary service area. The Dallas-Fort Worth region includes four major river basins.

Not all banks had secondary or tertiary service areas. OXBOW mitigation bank credits were excluded because the bank's service area was not available on RIBITS. The Trinity River Mitigation Bank's service areas do not follow the description above, but are generally limited by county boundaries. The Anderson Tract Mitigation Bank, which only serves Texas Department of Transportation (TxDOT) projects, also follows different service area boundaries.

Maps were made for wetlands without differentiating between types of wetlands, because different mitigation banks use different methods to identify wetland types. Maps were made for the different categories of streams described in the USACE Fort Worth District's Stream Mitigation Method. This was done to help the North Central Texas Council of Governments (NCTCOG) better judge what type of stream credits may be experiencing shortages.

Using ArcGIS, available credits generated from credit ledgers were joined with the spatial data identifying whole HUC-8s and portions of HUC-8s divided by ecoregion.

Mapping Combined Existing Wetlands

The combined existing wetlands map illustrates any area identified by either the National Wetlands Inventory, the National Land Cover Database, or the Ecological Mapping Systems of Texas. However, areas identified as developed by the National Land Cover Database were removed because the National Wetlands Inventory for the region was mapped in 1981 and 1982, and some wetlands at that time likely have been converted to other land uses.

This most inclusive wetlands dataset was used when estimating credit demand created by roadway projects. The area identified in this dataset also was used to ensure that existing wetlands were excluded when mapping potential wetland restoration sites.

Mapping Greatest Likelihood of Existing Wetlands

This wetlands dataset illustrates areas identified as wetlands by one, two, or three of the national or state wetland datasets.

Areas identified by at least two of these datasets were used when mapping potential wetland enhancement sites to increase the likelihood that sites were existing wetlands.

Mapping Potential but Unreleased Wetland and Stream Mitigation Credits

Potential but unreleased credits were quantified from mitigation bank credit ledgers by subtracting the number of credits in the released credits column from the number of credits in the potential credits column. This latter number is the total number of credits USACE identified that the bank could potentially generate at full build-out. The released credits are those that the USACE has approved for the bank to sell, regardless of whether they have sold or are still available. The difference between these two columns is the number of credits the bank could possibly generate in the future should it complete build-out. These potential but unreleased credits were mapped following the same methods described for mapping available wetland and stream mitigation credits.

Mapping Potential Mitigation Sites

Stakeholder input helped NCTCOG select spatial data that could identify and prioritize potential sites for mitigation banks.

Research on similar projects by other agencies also served as references for data to identify potential mitigation sites. Conservation groups have identified the need to protect aquatic resources, and transportation agencies have identified the need to identify mitigation sites to compensate for the unavoidable impacts of transportation projects. Some groups and agencies have developed geographic information system (GIS) models to map potential conservation and mitigation sites. These efforts influenced the data and methods used during NCTCOG's Mitigation Assessment. However, the majority of these projects addressed wetlands. The project conducted by West Virginia Division of Highways and West Virginia University was one of the few projects NCTCOG found that addressed stream mitigation in detail.

Below is a summary of projects and their influence on the Mitigation Assessment. Many similar projects exist, and this summary is not intended to be a comprehensive list of similar projects.

Virginia Wetlands Catalog

This project sought to identify wetland conservation and restoration sites. The following data sources in the Virginia Wetlands Catalog (Weber & Bulluck, 2014) led NCTCOG to include similar data sources during the Mitigation Assessment:

Potential Wetland Soil Landscapes (PWSL): This category in the Gridded Soil Survey Geographic Database (gSSURGO) identifies existing wetlands, areas that likely were historic wetlands that have been converted to another use, and areas that are not wetlands but could support existing wetlands (Waltman, 2013). The category incorporates data on hydric soils, drainage, flooding, ponding, and other factors (Waltman & Vasilas, 2013).

Intensity of development: The Virginia project's use of this data led NCTCOG to include the Ecosystem Sustainability layer from the agency's Regional Ecosystem Framework (REF). The Ecosystem Sustainability layer includes factors that fragment or stress ecological systems such as land use, road density, and superfund sites (NCTCOG, 2014).

Combined wetland data sources: The Virginia Wetlands Catalog used additional sources to supplement the spatial data on wetland locations in the National Wetlands Inventory (NWI) produced by the U.S. Fish & Wildlife Service (USFWS). The additional data sources helped the project establish the likelihood that wetlands existed at a site. NCTCOG took a similar approach by using the NWI, National Land Cover Database (NLCD) produced by the U.S. Geological Survey (USGS), and the Ecological Mapping Systems of Texas (EMST) produced by Texas Parks & Wildlife Department (TPWD). This was necessary because the data sources have their limitations. For example, the National Wetlands Inventory was conducted in North Central Texas in 1981 and 1982 (USFWS, 2015). The region's population grew by about 3.8 million people from 1980 to 2010 (U.S. Bureau of the Census, 1992 and NCTCOG, 2016), increasing the likelihood that some wetlands identified in the National Wetlands Inventory have been converted to other uses. While the 2011 NLCD used for the Mitigation Assessment is currently undergoing a review for accuracy, a review of the 2006 NLCD found an accuracy rate of 84 percent (EPA, n.d. a).

Maryland Watershed Resources Registry

This project yielded an interactive Website that allows users to search for opportunities to preserve or restore functions such as riparian area or natural stormwater infrastructure (Maryland State Highway Administration et al., n.d.). This project can identify mitigation for transportation projects while meeting the needs of a watershed.

Absolute and relative factors: The Watershed Resources Registry introduced NCTCOG to the concept of spatial data that must be met (absolute factors) to identify a site, and those that ideally will be met (relative factors) to identify a site with the most desirable qualities. For example, a potential site for wetland enhancement must be an existing wetland, and a site in a wildlife corridor could help protect wildlife communities in addition to meeting mitigation requirements.

Green infrastructure hubs and corridors: The Maryland project's use of a state-level layer on green infrastructure hubs and corridors led NCTCOG to seek out the National Ecological Framework, a national dataset from Environmental Protection Agency (EPA) Region 4 that identifies areas that provide ecological connectivity (EPA, n.d. b).

Property data: The Watershed Resources Registry allows users of the Website to link to the state's Department of Assessment & Taxation real property database. NCTCOG planned to analyze property ownership and value data during the project-level considerations portion of the Mitigation Assessment.

North Carolina Ecosystem Enhancement Program

North Carolina's Ecosystem Enhancement Program, now known as the Division of Mitigation Services, serves as a model for a public-private partnership to ensure mitigation occurs in advance of transportation impacts. NCDOT provides the program with its estimated mitigation needs for the next seven years' worth of transportation projects. The program purchases land, designs and constructs mitigation sites, and monitors the sites. The sites are selected with stakeholder input to meet the needs of the watershed. The North Carolina Department of Transportation (NCDOT) pays its mitigation costs quarterly. Private mitigation banks also may sell credits to the Division of Mitigation Services (North Carolina Department of Environmental Quality, n.d.).

Decision Support for Regional Advance Mitigation Planning

This project, conducted by NatureServe and the Pikes Peak Area Council of Governments, quantified impacts of the long-range transportation plan for the Colorado Springs area. Those impacts included aquatic resources, species habitats, and ecosystem types (Crist et al., 2015).

Estimating impacts: The Decision Support tool provided the basis for NCTCOG's method to estimate impacts of roadway projects recommended in Mobility 2040. NCTCOG will follow this project's lead to identify each roadway project by the significance of its impact. This will help identify which projects may require greater environmental planning.

Future land use: The Decision Support tool's use of future land-use scenarios led NCTCOG to consider municipalities' future land-use plans, when available, in the agency's project-level analysis.

Watershed Approach for Maximizing Ecological Lift through Compensatory Mitigation Activities

This project, conducted by West Virginia University's Environmental Research Center on behalf of the West Virginia Division of Highways, provided a model for data sources to help identify stream mitigation sites (Environmental Research Center, 2013).

Land use: The West Virginia project used benthic macroinvertebrate models to measure downstream impacts created by different land uses. While the Mitigation Assessment could not duplicate this method, NCTCOG did refine its scale for agricultural land use and impervious surface cover from the HUC-12 scale to the finer catchment-level scale available from the National Hydrography Dataset Plus (NHDPlus) Version 2 (Horizon Systems Corporation, 2012).

Minimum size for mitigation site: NCTCOG adopted the 10-acre minimum threshold for wetland mitigation sites as suggested by the West Virginia project. Setting a minimum size allows for economy of scale when conducting mitigation and provides greater benefits to the watershed. However, larger mitigation sites may require purchasing land from and/or establishing conservation easements on the property of a greater number of landowners.

Mapping Potential Wetland Restoration Mitigation Sites

To determine potential wetland restoration mitigation sites, ESRI ArcMap's Model Builder functionality was used to combine a series of input datasets. Conditions that had to be met for the areas shown by each of the datasets were defined, and each dataset input was classified as an absolute or relative factor. Areas that did not meet the conditions stipulated by an absolute factor were eliminated from further analysis. Areas that met the conditions stipulated by a relative factor were assigned points based on their ranking: High rankings received three points, Medium rankings received two points, and Low rankings received one point. These scores were summed together to yield the final result.

Below are the data layers used to map and prioritize these sites; included are the absolute and relative factors and their rankings.

Wetland Restoration Site Data Layers		
Data layer (Source)	**Absolute/Relative**	**Ranking**
NWI, NLCD Wetlands, EMST Wetlands (USFWS, USGS, TPWD)	Absolute - cannot be existing wetlands	N/A
Potential Wetland Soil Landscapes (gSSURGO)	Absolute - must have a PWSL score of at least 80	N/A
NLCD Developed Land (USGS)	Absolute - cannot be developed	N/A
Conservation Easements (National Conservation Easement Database)	Absolute - not within existing conservation easement	N/A
National Hydrography Dataset (USGS)	Relative - if located within 500 feet or intersects an existing water body	High
DFIRM floodplains (FEMA)	Relative - if located within 100-year floodplain	Low
Category 4 and 5Impaired Water Segments (TCEQ)	Relative - if located in a HUC12 with an Impaired Water Segment	Medium
Ecologically Significant Stream Segments (TPWD)	Relative - if located in a HUC12 with an Ecologically Significant Stream Segment	Medium
WPPs and Bacteria I-Plan (TCEQ, NCTCOG)	Relative - if located within a Watershed Protection Plan or Bacteria I-Plan area	Medium
National Ecological Framework (EPA Region 4)	Relative	High score if located in hub or corridor connection or medium score for auxillary areas as defined by NEF
Conservation Easements (National Conservation Easement Database)	Relative - if located within 500 feet of an existing conservation easement	High
Priority Conservation Areas (The Nature Conservancy)	Relative - if located in a priority conservation area defined by the TNC	Medium
Wildlife Management Area (TPWD)	Relative - if located within 500 feet of an WMA	Medium
Soil taxonomy (NRCS)	Relative - if aquerts or aquolls are present	Medium
Texas Natural Diversity Database, Species of Greatest Conservation Need (TPWD)	Relative - TxNDD County scores: High = 2; Medium = 1; Low=0	Medium
REF Diversity (NCTCOG)	Relative - if intersects with a grid cell with a score of 5	Low
REF Wildlife Habitat (NCTCOG)		
REF Rarity (NCTCOG)		
REF Sustainability (NCTCOG)		

Table 1: Wetland Restoration Site Data Layers

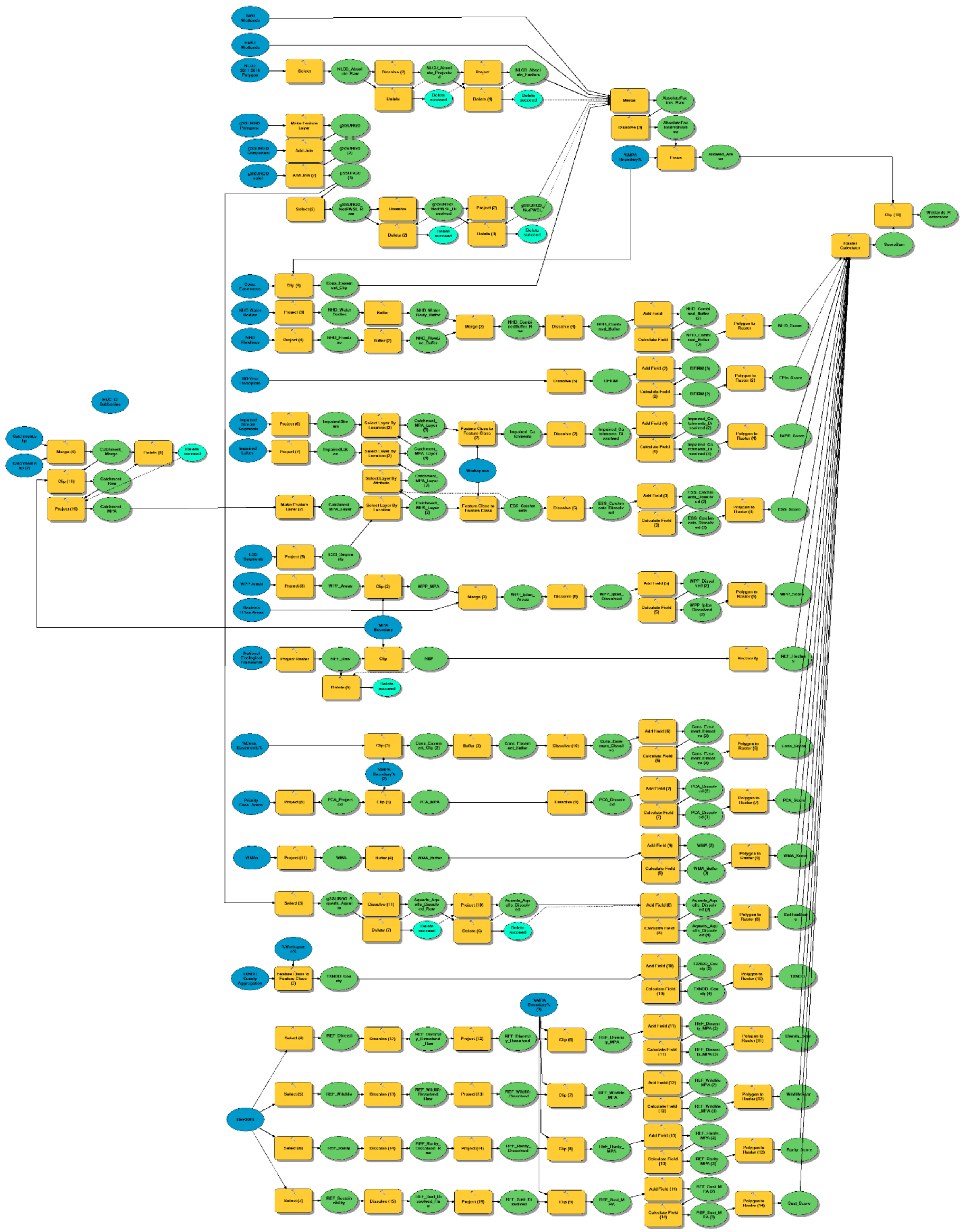


Figure 1: Potential Wetland Restoration Mitigation Sites GIS model

Mapping Potential Wetland Enhancement Mitigation Sites

As with wetland restoration, ESRI ArcMap's Model Builder functionality was used to combine a series of input datasets. Conditions that had to be met for the areas shown by each of the datasets were defined, and each dataset input was classified as an absolute or relative factor. Areas that did not meet the conditions stipulated by an absolute factor were eliminated from further analysis. A key difference here is that sites had to be an existing wetland to move forward in the analysis; with wetland restoration, a site could not be an existing wetland. Areas that met the conditions stipulated by a relative factor were assigned points based on their ranking: High rankings received three points, Medium rankings received two points, and Low rankings received one point. These scores were summed together to yield the final result.

Below are the data layers used to map and prioritize these sites; included are the absolute and relative factors and their rankings.

Wetland Enhancement Site Data Layers		
Data layer (Soruce)	**Absolute/Relative**	**Ranking**
NWI, NLCD Wetlands, EMST Wetlands (USFWS, USGS, TPWD)	Absolute - must be existing wetlands	N/A
NLCD Developed Land (USGS)	Absolute - cannot be developed	N/A
Conservation Easements (National Conservation Easement Database)	Absolute - not within existing conservation easement	N/A
National Hydrography Dataset (USGS)	Relative - if located within 500 feet or intersects an existing water body	N/A
DFIRM floodplains (FEMA)	Relative - if located within 100-year floodplain	N/A
Category 4 and 5 Impaired Water Segments (TCEQ)	Relative - if located in a HUC12 with an Impaired Water Segment	Medium
Ecologically Significant Stream Segments (TPWD)	Relative - if located in a HUC12 with an Ecologically Significant Stream Segment	Medium
WPPs and Bacteria I-Plan (TCEQ and NCTCOG)	Relative - if located within a Watershed Protection Plan or Bacteria I-Plan area	Medium
National Ecological Framework (EPA Region 4)	Relative	High score if located in hub or corridor connection or medium score for auxillary areas as defined by NEF
Conservation Easements (National Conservation Easement Database)	Relative - if located within 500 feet of an existing conservation easement	High
Priority Conservation Areas (The Nature Conservancy)	Relative - if located in a priority conservation area defined by the TNC	Medium
Wildlife Management Area (TPWD)	Relative - if located within 500 feet of an WMA	Medium
Texas Natural Diversity Database, Species of Greatest Conservation Need (TPWD)	Relative - TxNDD County scores: High = 2; Medium = 1; Low=0	Medium
REF Diversity (NCTCOG)	Relative - if intersects with a grid cell with a score of 5	Low
REF Wildlife Habitat (NCTCOG)		
REF Rarity (NCTCOG)		
REF Sustainability (NCTCOG)		

Table 2: Wetland Enhancement Site Data Layers

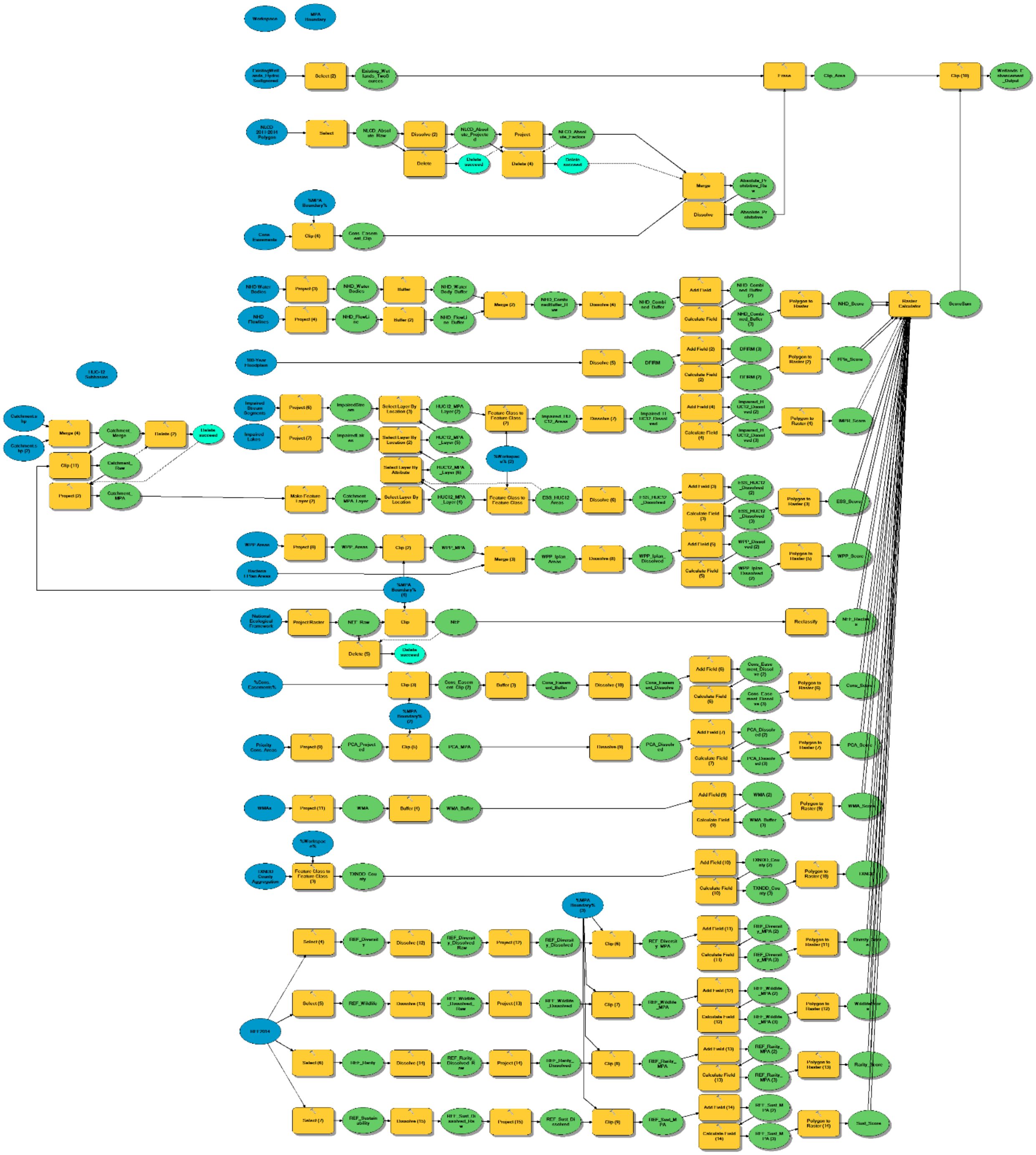


Figure 2: Potential Wetland Enhancement Mitigation Site GIS Model

Mapping Potential Stream Enhancement Mitigation Sites

As with wetland restoration and wetland enhancement, ESRI ArcMap's Model Builder functionality was used to combine a series of input datasets. Conditions that had to be met for the areas shown by each of the datasets were defined, and each dataset input was classified as an absolute or relative factor. Areas that did not meet the conditions stipulated by an absolute factor were eliminated from further analysis. A key difference here is that sites had to be on an existing stream as defined by the National Hydrology dataset; where wetland restoration and enhancement, presence or absence of an existing wetland was a comparable absolute factor. Areas that met the conditions stipulated by a relative factor were assigned points based on their ranking: High rankings received three points, Medium rankings received two points, and Low rankings received one point. These scores were summed together to yield the final result.

Below are the data layers used to map and prioritize these sites; included are the absolute and relative factors and their rankings.

Stream Enhancement Site Data Layers		
Data layer (Source)	**Absolute/Relative**	**Ranking**
National Hydrography Dataset (USGS)	Absolute - must be existing stream	N/A
Conservation Easements (National Conservation Easement Database)	Absolute - not within existing conservation easement	N/A
Category 4 or 5 Impaired Water Segments (TCEQ)	Relative - if located in an NHDPlus catchment with an Impaired Water Segment	High
Ecologically Significant Stream Segments (TPWD)	Relative - if located in the same NHDPlus catchment as an Ecologically Significant Stream Segment	High
WPPs and Bacteria I-Plan (TCEQ and NCTCOG)	Watershed Protection Plan or Bacteria I-Plan area	Medium
National Ecological Framework (EPA Region 4)	Relative - 1 if located in hub or corridor connection or zero for auxillary areas as defined by NEF	Low
Conservation Easements (National Conservation Easement Database)	Relative - if located within 150 feet of an existing conservation easement	High
Priority Conservation Areas (The Nature Conservancy)	Relative - if located in a priority conservation area defined by the TNC	Medium
Wildlife Management Area (TPWD)	Relative - if located within 150 feet of an existing conservation easement	Low
Impervious Surface (NLCD)	Percent impervious surface within NHDPlus Catchment area. < 10 percent scores 1; 10% to 25% scores 3; > 25% to 60% scores 2; > 60 percent scores 0	High
Agricultural Land Cover (NLCD)	Percent agriculture (NLCD pasture/hay and cultivated crops) within NHDPlus catchment area. 0-33% scores 0; 34%-66% scores 1; > 66% scores 2	Medium
Soil Erodibility k-factor (gSSURGO)	K <= 0.2 (low erodibility) scores 0; 0.2 < k <= 0.4 (moderate erodibility) scores 1; k >= 0.4 (high erodiblity) scores 2	Medium
Texas Natural Diversity Database, Species of Greatest Conservation Need (TPWD)	Relative - TxNDD County scores: High = 1; Medium = 0.5; Low=0	Low
REF Diversity (NCTCOG)	Relative - if intersects with a grid cell with a score of 5	Low
REF Wildlife Habitat (NCTCOG)		
REF Rarity (NCTCOG)		

Table 3: Stream Enhancement Site Data Layers

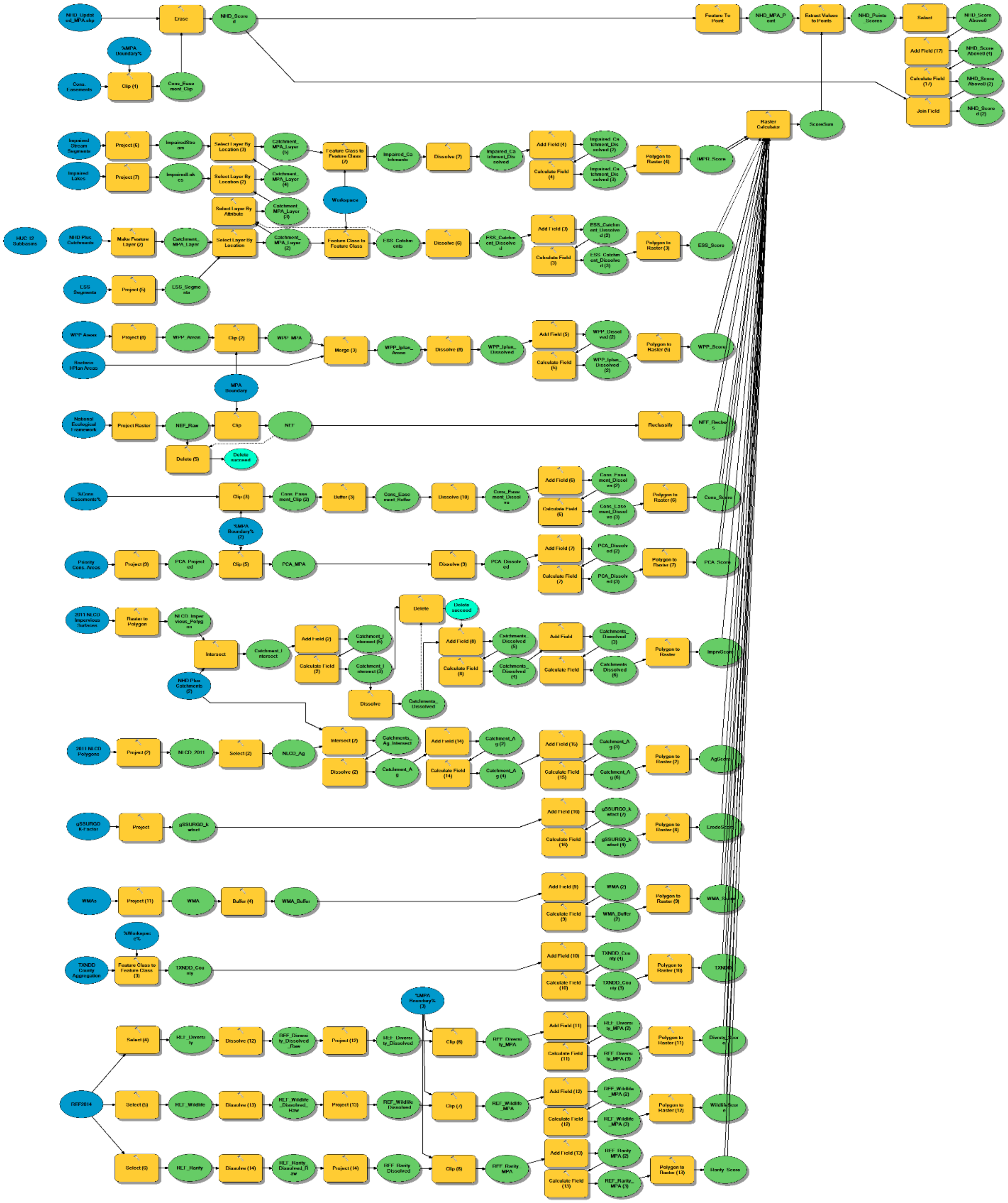


Figure 3: Potential Stream Enhancement Mitigation Site GIS model

Calculating Low, Medium, and High Estimates for Credit Demand Generated by Roadway Segments

This analysis sought to classify the stream and wetland impacts of upcoming transportation projects as a way to estimate mitigation demand. The core inputs were a line network of upcoming roadway projects split by HUC-8 watersheds, and a detailed table describing the roadway projects' current and future widths using a series of standardized estimates (see Table 4 below). Those areas that were estimated to be impacted by new road construction or road widening by 2027 were overlain by perennial streams, intermittent streams, and existing wetlands. No spatial data on ephemeral streams were available. Linear feet of impact was calculated for streams, and impacted acreage was calculated for wetlands. These impacts were statistically grouped into High, Medium, and Low classifications using quartiles: all impacts falling below the median (50th percentile) were classified as Low, while those between the median and the 3rd quartile (75th percentile) were classified as Medium, and those above the 3rd quartile were classified as High.

A method to specifically determine the number of credits needed to compensate for unavoidable impacts could not be created because:

- Some of the stream or wetland impacts likely will be avoided or minimized during design of the final alignment
- Single and complete crossings could not be identified
- Ephemeral streams spatial data were not available
- It could not be determined whether impacts would meet thresholds that require compensatory mitigation because the jurisdiction of the wetlands and streams in the spatial data could not be determined
- The widths of streams could not be determined, though the following typical widths (TxDOT, 2014) were applied to roadways:

Roadway Feature	Impact Area Width
Clear Zone	30 Feet
Frontage Lane	12 Feet
Main Lane	12 Feet
Managed Lane	12 Feet
Managed Lane Barrier	6 Feet
Median	30 Feet
Shoulder	10 Feet
Right of Way	25 Feet

Table 4: Typical Roadway Widths

Mitigation thresholds that affect linear transportation projects are described below:

Mitigation Requirements Related to NWP 14

IF NO PRECONSTRUCTION NOTIFICATION (PCN) IS TRIGGERED

Compensatory mitigation may still be required if USACE determines that the project will create more than minimal adverse effect

TRIGGERS FOR PCN

Impacts to Waters of the US, if the impact:

- Affects special aquatic sites[1], such as jurisdictional wetlands, riffle and pool complexes in intermittent or perennial streams, or mud flats
- Affects streams or ponds and is greater than 1/10th acre
- Is a regional condition, such as pitcher plant bogs in the Fort Worth District

Section 106 of the National Historic Preservation Act, Section 7 of the Endangered Species Act, and others not related to Section 404 of the Clean Water Act

AFTER A PCN HAS BEEN TRIGGERED

Mitigation will be required **if the project creates more than minimal adverse effect**, including effects that meet one or both of the following thresholds:

- Loss greater than 1/10th of an acre to jurisdictional wetlands or streams or ponds
- Loss greater than 300 linear feet[2] of streams, even if loss is less than or equal to 1/10th of an acre and is the only impact to WOUS

Permittees would be required to mitigate for all impacts, even those that do not meet thresholds, if at least one aquatic resource meets the threshold. For example:

- When 3/10th of an acre of wetlands and 100 linear feet of streams are impacted, the permittee must mitigate for impacts to both wetlands and streams because the wetlands impact meets the threshold
- When 400 linear feet of streams and 1/20th of an acre of ponds are impacted, the permittee must mitigate for impacts to both streams and ponds because the streams impact meets the threshold

[1] See Subpart E of CFR 40 Part 230 Section 404(b)(1) Guidelines for a complete list
[2] See Nationwide Permit Regional Conditions for the State of Texas in Nationwide Permit 14

Figure 4: Mitigation Thresholds for Linear Transportation Projects

Overlaying Low, Medium, and High Estimates for Credit Demand on Regional Ecosystem Framework Layers

The potential credit demand generated by Mobility 2040 roadway projects by 2027 and 2040 were overlaid on appropriate layers from the REF. The REF is a tool that identifies areas of relative ecological importance in the Dallas-Fort Worth region. Transportation partners and local governments that are developing infrastructure projects can use the REF as a preliminary screening tool to identify environmental impacts their projects may have (NCTCOG, 2014). While the REF illustrates quantity of environmental and ecological resources, stakeholders thought it could be used to help conceptualize the quality of the areas being impacted. This helps the Mitigation Assessment address part of the functional assessment used by the USACE Fort Worth District as it determines the number of credits required to compensate for unavoidable impacts to wetlands and streams.

The following REF data layers were used in this analysis:

Wetlands:

- Wildlife Habitat: Includes NLCD-identified forest lands, shrublands, grasslands, wetlands, and open water.
- Diversity: Includes data on the appropriateness of land cover, contiguous size of undeveloped area, Shannon land cover diversity, and ecologically significant stream segments.
- Rarity: Includes data on vegetation rarity, natural heritage rank, taxonomic richness, and rare species richness.
- Ecosystem Sustainability: Describes the resiliency of an area when faced with disturbance. It includes data on factors that fragment habitat and stress habitat.

Streams:

- Wildlife
- Diversity
- Rarity

Project-Level Analyses

New roadway projects are among the Mobility 2040 projects that generate the highest estimated potential for credit demand. Three new roadway projects were selected for additional analyses to better identify potential sites for mitigation banks that could provide primary service-area credits for these projects.

Because wetland mitigation credits are generally plentiful in the HUC-8s through which the new roadways will travel, the project-level analyses were restricted to stream credits. A GIS model was developed to narrow down potential stream mitigation sites using data that were too complex to include in the original model or were not available as spatial data. Scores generated in the initial model of Potential Stream Enhancement Mitigation Sites were then applied to the potential mitigation site that remained.

Stream Enhancment Project-Level Analyses		
Data layer (Source)	**Absolute/Relative**	**Thresholds**
Identified potential mitigation sites (NCTCOG)	Absolute	Must be a site identified in previous model
PALM (TxDOT)	Absolute	Exclude any site that scores "high" potential for surface level or for deep artifacts -- these are the polygons that score 3, 6, 7, 8, or 9 [this may exclude everything though].
Brownfields (NCTCOG)	Absolute	Exclude any brownfield site
Superfund site boundaries (NCTCOG)	Absolute	Exclude any superfund site
Prime farmland (gSSURGO)	Absolute	Exclude prime farmlands
Primary service areas (USACE)	Absolute	Within a HUC8 that the roadway passes through
Land use (NCTCOG)	Absolute	Include only sites in parks/rec, vacant, residential acreage, ranch land, timberland, farmland, improved acreage, water, and small water bodies.
Scores from previous model (NCTCOG)	Relative	Assign scores from previous models to sites that remain after this model run

Table 5: Stream Enhancement Project-Level Analyses

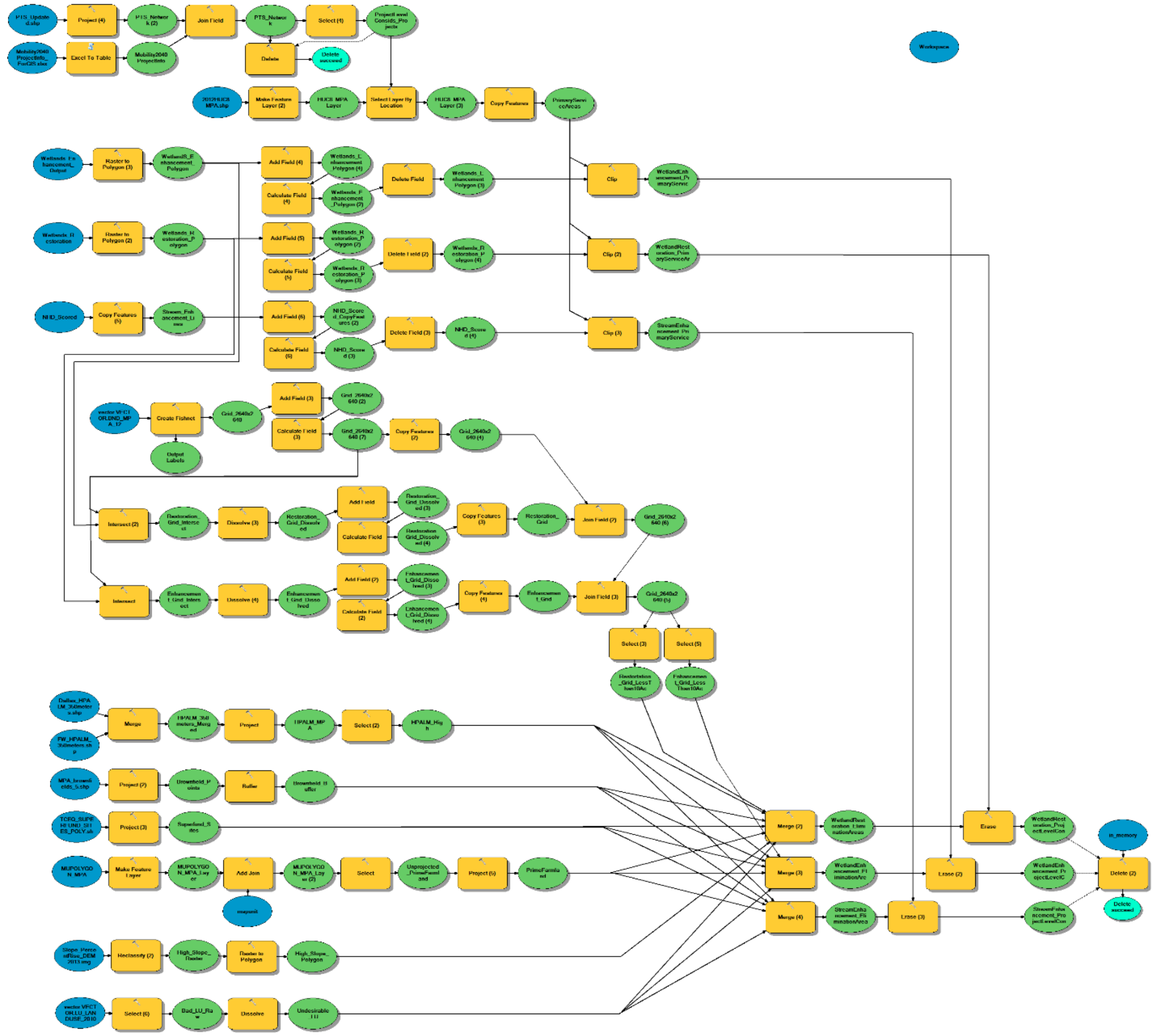


Figure 5: Stream Enhancement Project-Level Analysis GIS model

The sites that remained after the GIS project-level analyses went through further qualitative analyses. Those with the highest scores were compared against city future land-use plans and aerial photography to establish whether these factors could exclude sites. Any site that was an existing mitigation bank was excluded. Stream density also was considered to increase the likelihood that a site could produce sufficient credits. The qualitative analyses were to include the estimated cost and size of parcels using data acquired from county appraisal districts. However, a useful analysis of this data would have required knowledge and analysis by a land appraiser or an economist, which is beyond NCTCOG staff expertise; therefore, parcel data were not included.

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