CostQuest Associates (CQA)
Economic Research & Analysis

COSTQUEST ASSOCIATES

T-Mobile USF Mobility Model Report
October 1, 2012

CostQuest Associates (CQA) Economic Research & Analysis

For further information or if there are any questions or concerns contact:
research@costquest.com

Table of Contents

COSTQUEST ASSOCIATES

Introduction

The Goal of the Project

This project is designed to lay out the parameters and provide a proof of concept implementation of a forward looking economic cost model (“Model”) for use in determining the funding for a wireless High-Cost Universal Service Fund. The purpose of the effort is to estimate the cost to serve areas (and users) with 4G wireless broadband technology, determine commercial viability, identify areas in need of external funding support, and estimate support levels.

With this purpose in mind, CostQuest has developed and presents herein a Forward Looking Economic Cost (“FLEC”) Model that estimates the costs for wireless mobility and broadband services. Currently, fifteen states have been loaded and processed. In this study, CostQuest presents the output of fifteen states that represent diverse topographies, network coverage and population density.

Modeling Concepts

Whether considering forward looking economic costs, reverse auctions, or cost accounting methods, a model of some sort forms the necessary background for funding. Indeed, every current universal funding program actually relies upon both a “cost model” and a “support model”.

A “cost model” is a systematized collection of mathematical procedures that takes as inputs geographic and non-geographic data and that produces an estimate of the cost of providing a telecommunications service. As such, a cost model is designed to provide a normalized measure of investment and operational costs so that policy choices, technologies, carriers and geographic areas can be compared on a fair and impartial basis. For example, a cost model will help address the impact to cost of broadband options; the cost of various technologies, costs under different market conditions, and assumptions concerning the components of a network.

A “support model” uses a mathematical procedure that takes cost data as an input, sets a standard for acceptable customer payment or affordability, applies a funding method (regulatory or carrier based), to produce an amount of subsidy/support necessary for the carrier to deliver the modeled services to high cost customers.

All support models rely on the integrity of cost data from the cost model to provide a solution. CostQuest’s dual focus on this project was to develop a robust and accurate cost model and develop a flexible support model whose parameters provide the user with key variables to understand support policy decisions. It is the Model users’ responsibility to determine the final inputs and overall design of the Model and the various policy decisions that influence the Model’s results.

Overview of Project

In summary, CostQuest is presenting a Model that estimates the costs for wireless mobility and broadband services on a state by state basis for selected states. Using the cost output, the Model then provides a platform to investigate high-cost support issues.

The Model is based on:

- An application which realistically models the appropriate investments and costs to operate and maintain a 4G mobile network.
- Methodologies that are consistent with FCC objectives in developing costs for USF.
- Methodologies that are consistent with recent efforts by the FCC to understand the cost of broadband deployment.
- A design that captures the upfront investment to deploy and the ongoing cost to maintain a 4G mobile network.
- The assumption that there will be deployment of HSDPA+, LTE or WiMAX technologies and these networks will be sensitive to the size of demand, frequency propagation, geography of the study area and network engineering characteristics.
- The notion that operational costs are incurred by an efficient provider along with the capital costs associated with the network deployment.

The support model provides toggles that allow the user to:

- Determine the level of geography for funding development.
- Input an overall cap on total funding.
- Input a support cap to limit the per subscriber funding.
- Input a funding cutoff to exclude funding to customers whose costs are excessive.
- Input the assumed level of competition.
- Input the assumed level of subscriber Revenue (i.e., a benchmark) above which an area would be uneconomically viable to serve.

Based on these inputs, the support model then determines the geographic areas that require funding, thereby providing an efficient disbursement of the limited support dollars.

Model - Overview and Methods

High Level Methodology

The purpose of the Model is to estimate the cost to serve areas (and users) where consumers reside, determine commercial viability, identify areas in need of additional funding support and estimate funding levels.[1] The high level methodology used in the modeling includes:

- Determination of where advanced wireless services, or 4G wireless coverage,[2] is needed but not currently available
- Identification of existing assets that can be leveraged to provide 4G coverage
- Analysis of the area requiring coverage and determination of what additional assets need to be deployed to provide 4G coverage

[1] The model does not currently address unserved areas such as national parks or highways where consumers reside or travel. We are currently reevaluating a bolt-on modification to the model to add what it might take to also cover such areas.

[2] '4G' coverage is defined as the ability to receive OFDM technologies or HSPA+. If an area had no '4G' service, the area was categorized as unserved by '4G' and the area was augmented from existing 2G or 3G infrastructure (if available) or built as a 'greenfield' site.

- Determination of the costs to maintain and operate the modeled network assets, service customers, and support commercial business operations[3]
- Assessment of whether a service area is commercially viable (i.e., can operate at a positive contribution margin) or is in need of additional support (i.e., would operate at a negative contribution margin)

Further Explanation of the Methodology

Coverage Determination – Utilizing industry service data[4] on wireless network deployments as of the end of 2011, a determination was made regarding the extent of 4G wireless coverage in the jurisdictions modeled. The model was then used to develop results for those areas unserved by 4G technology within a jurisdiction. The model also developed results for all areas within a jurisdiction for comparative purpose.

Coverage Analysis – Each modeled state jurisdiction was divided into areas approximating the coverage of a single wireless base station using spectrum currently available to commercial mobile radio service providers (cell coverage areas). For this study, coverage characteristics were developed in concert with T-Mobile network planning staff to reflect estimated network performance for 700MHz and 1900MHz spectrum. The resulting cell coverage areas (varying in size from less than one square mile to as much as 310 square miles) were superimposed over the targeted jurisdictional coverage area. Those cells without any population or including major roads without population were dropped from further analysis.[5] It was assumed that new technology was needed in each of the remaining cells (those without any coverage), providing an estimated count of new technology investment sites needed to provide the desired 4G service coverage.

Capital Investment Development – Based on the count of cell coverage areas and an assumed mix of owned and leased tower sites, an investment profile was developed and applied to the count of cell coverage areas requiring leased space on existing structures and the count of cell coverage areas requiring a tower build. Estimates of the investment required were drawn from industry sources. The model also develops the backhaul and core network investments necessary to support the network operation.

Monthly Expense Development – Representative U.S. domestic wireless average operational expenses for network, customer, general, and administrative functions were analyzed to develop cost inputs that were driven on either cell coverage area or the number of subscribers. Investment cost annualization, which captures depreciation along with

---

[3] This study is not an attempt at creating an actual final cost or a precise tower count necessary for building and operating a 4G wireless network. Rather, this model is an important step in a multi-effort process that will involve accurately identifying locations, investments, operating costs, and potential subsidies related to support of ubiquitous 4G wireless broadband coverage.

[4] See www.americanroamer.com. While American Roamer's *Coverage Right* wireless coverage maps are clearly the best available source for mobile broadband coverage, there remain issues with the ability to verify coverage on the frontiers of service areas.

[5] This is an assumption that coverage is unnecessary where there are no households, businesses, or significant roadways. However, we are currently reevaluating incorporating a bolt-on modification to the model to determine the additional funding required to serve such areas.

financing costs and taxes, was included with operational expenses to produce a total monthly expense. This total monthly expense was equally apportioned to each assumed subscriber in the target service area, which then can be rolled up to the census block the subscriber was within to derive a monthly cost per user per census block.

Commercial Viability – Estimated monthly service revenues were compared to the monthly costs of owning and operating a 4G network and services to determine a contribution margin for each census block. A census block with a positive contribution margin is considered commercially viable and not "in need" of support. A census block with a negative contribution margin is assumed to require additional support for a commercial operator to provide service. To determine the support funding necessary for non-commercially viable areas, the monthly negative contribution is multiplied by the number of users in the census block.

Key Assumptions - In addition to the above, two key assumptions are included in the model to reflect potential support funding constraints. These constraints have a significant impact on the modeled support requirements.

- Number of Competitors: The Model can be run assuming a single service provider network with a 100% market share in the targeted coverage areas, two providers each with a 50% market share in the targeted coverage areas, or various other scenarios for competition and market share. The results filed with this documentation assume a single network.

- Monthly Funding Cutoff: The Model includes the ability to establish a threshold for the maximum amount of funding that would be used to support a subscriber. This cutoff is included to deal with the highest cost areas that are unlikely to be served with a 4G wireless technology because the cost to serve is substantial. For example, a funding cutoff established at $250 per month means that census blocks requiring a monthly support level in excess of $250 per user would not be funded. The results filed with this documentation assume a $250 monthly funding cutoff.[6]

Background & Overview of Modeling

The modeling was developed at the behest of T-Mobile to meet several goals. These goals included evaluation of policy considerations applicable to calculating funding necessary to support the build-out of high cost service areas, highlighting of policy considerations relevant to determining a funding mechanism for CAF II funding, and the impact of high band versus low band spectrum focusing on the necessity of realistic thinking with respect to the cost of build out of advanced services networks. As part of this analysis, the wireless model is designed to fill a critical information gap by providing an estimate of the financial impact associated with providing wireless services (including broadband data) to specific operating areas across the U.S.

The design logic, methods, and structure of the wireless network model used as the basis for deriving a forward looking cost to serve is accomplished through the application of CostQuest

[6] A $250 cutoff was chosen to reasonably cover a broader section of the potential unserved or underserved areas while maintaining a reasonable fund size.

Wireless® to specific operating conditions and objectives of the user. The underlying wireless network architecture is created through CostQuest Wireless® deriving investment and operating costs from inputs developed using publicly available U.S. wireless operator information. The modeled architecture employs a granular approach, the use of spatial analysis and a set of defined 'real world' engineering rules as the approach to modeling network design. The resulting bottom-up costing takes into account demand across all modeled services to establish minimum backhaul routing, traffic demanded at or traversing a network node, sizing and sharing of network components, and capacity and component exhaustion. Output unit costs are developed using a capacity costing technique and include all necessary plant, structure and electronics to support the designed network.

The economic modeling conducted for T-Mobile develops an estimate of the network required to provide a desired level of service along with the costs of operating that network, including obtaining and maintaining customers on the network. The modeling of the network includes all components to prepare the service delivery system for productive use.
Central to understanding the resulting network topology created by the model is an appreciation of the underlying inputs, assumptions and economic models.

- Inputs, as outlined in this document, are based on publicly available data using published industry information.
- Assumptions reflect real-world/current engineering practices, including how these practices are applied within specific terrain.
- The central economic model is a widely accepted state-of-the-art approach using network modeling practices standard throughout the industry.

The Model is designed to provide results at a census block level. Census blocks are a primary unit of data collection and presentation thereby allowing for granular analysis of relevant information (e.g., infrastructure, demographic, and economic), including the cost to provide wireless service. Census block data can then be rolled up into larger geo-political areas as desired (e.g., license areas or study areas).

Introduction to CostQuest Wireless

CostQuest Wireless® is the configuration engine for the wireless communications network used in the cost model. It produces the network topology including tower counts, radio access network ('RAN') capacity configuration, backhaul type, distance of backhaul fiber, etc. The network design is a customized, forward-looking network developed on a customer-by-customer analysis of network utilization. The cost of the network is then developed within the model.

What sets the CostQuest Wireless® platform apart from other modeling approaches and methods is its granular approach, its use of spatial analysis, and its reality-based engineering guidelines. CostQuest model platforms are used by companies with operations in over 40 states in the U.S., have been used in property tax valuations, have been used to value networks in acquisitions, and have been used by international government agencies.

CostQuest Wireless® determines the topology for wireless network components across all categories of plant required to connect specific customer sets to a serving tower and to provide a wide-range of wireless services to these customers. The Model assumes the installation of forward looking, commercially available telecommunications technologies and uses generally accepted engineering practices and procedures. The design criteria was targeted to practical dimensioning of a deployable network and simplifying assumptions that underpin the logic, purpose, and the computational strategy have been employed.

CostQuest Wireless®Process

Locating Wireless Users

Within CostQuest Wireless®, demand (e.g. population, number of households, housing units, business locations,) is processed and allocated at the Census Block level. Because available data does not exist to precisely pinpoint the location of both business and residential populations customer demand must be estimated using a combination of secondary data sources.

Demand is distributed within each census block boundary based upon locations of Housing Units where eligible roads exist. Where no roads exist, a random scatter process is used to place demand. Take rates are provided as a user input and applied to the demand locations within a census block to determine the required network design.

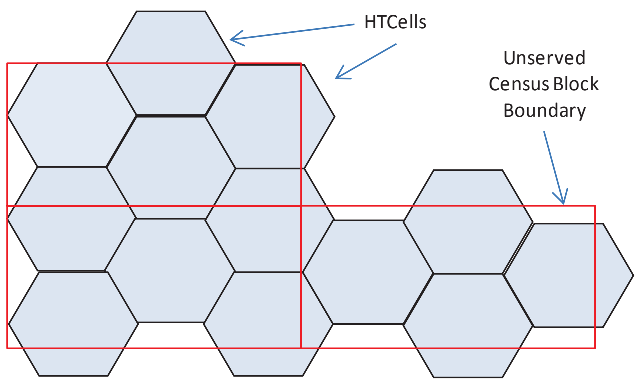
Coverage Approach

The methodology for creating coverage in the modeled wireless architecture is intended to produce a reasonable dimensioning of base station requirements for early stage network planning.

Existing tower sites can be incorporated into the model and used as the basis for existing coverage. However, the model can also be run without known towers. In the instance where towers are not available CostQuest Wireless® employs a method using hexagonal tessellation cells (HTCell) to approximate site coverage in unserved areas.

HT Cell

The use of HTCell is symbolic of a three sector cell site and the hexagonal shape provides a method to simulate 100% coverage. The following diagram depicts a hypothetical overlay of HTCells in three Census areas deemed to be unserved by existing coverage. In this example, the unserved area could be covered by thirteen HTCells.



For purposes of this model, each HTCell is assumed to house at least one antenna site. In the case where an existing site structure is used to place a new site antenna, the actual location of that tower is used in the model. In the case of a 'greenfield' build, the site is assumed to be at the center point of the HTCell.

The tower set that the model incorporated was created from a range of HTCell sizes from as small as half a mile to twelve square miles. The criteria for HTCell sizing included population density and terrain variation. Census tracts were used as the base geography for this process, but were split further into block groups in high density areas. For these high density areas, sensitivity triggers based on the number of business locations provided extra tower locations. As HTCells of different sizes are placed together, demand locations are routed to their nearest tower (within the HTCells) to create the service footprint of each tower, as shown below.

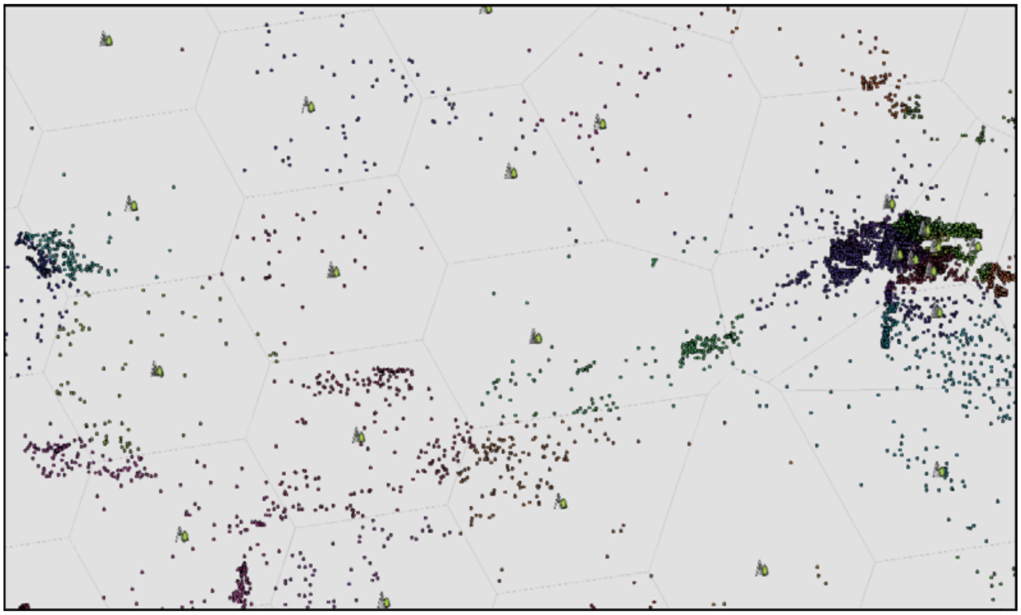


Figure 1---Demand locations within HT Cells

To deal with tower sites where demand exceeds the capacity of a single site, cell splitting methodology is used that results in the addition of one or more sites to meet the overall capacity demanded within the tower site.

It is important to note that variances in accuracy that occur at the HTCell will tend to be mitigated as the model is applied to larger aggregations of unserved area census blocks (e.g., in market areas).

<u>Backhaul Design and Investment</u>

In today's market, landline backhaul is typically leased from another provider (typically a LEC). As such, the current version of the model loads in landline backhaul as an operation cost. In regard to microwave backhaul, the current version of the inputs assumes an average investment associated with all towers.

However, the Model has the capability to capture the investment associated with backhaul at each tower if needed. The design for backhaul (also called second mile) of the wireless network involves the transport of traffic between an existing fiber point of interconnection (POI) (typically the MSO) and the deployed tower sites (Node 2 sites) in the identified service area. The backhaul design incorporates both fiber and microwave in an efficient manner. The model relies on a series of steps for the development of backhaul routes:

- Identification of existing fiber POIs. For the T-Mobile run, existing mobile switching offices were designated as fiber POIs.
- Association of cell sites to the nearest existing fiber POI. The Node 2 sites are assigned to the nearest POI to create the initial spatial relationship (“parentage”) that is most likely to provide least cost backhaul routing.
- For Node 2 sites subtending the same POI, the establishment of backhaul routes uses a spanning tree approach based on shortest distance routing to the POI. Beginning with the most distant Node 2 site, each site is routed to next closest cell site using the estimated lowest cost transport medium (i.e., fiber or microwave) subject to performance parameters of that medium.

The use of microwave backhaul is subject to a link distance threshold. Typically, the maximum microwave link distance was set at 20 miles. If maximum link distance is exceeded the model assumes the site needs to be served by fiber.

The backhaul design is sensitive to the aggregate demand associated with linked sites in a service area. The methodology used is based on threshold bandwidth capacity of microwave links over differing distances. The use of microwave backhaul is also subject to a threshold parameter for the number of microwave links that can be supported at a single tower. This is a user selectable parameter. If the parameter is exceeded at a site, the model assumes the site needs to be served by fiber.

Output to Costing Component of Model

Once the CostQuest Wireless® topology/design is complete, two files per state are stored in the model databases. The DIST file contains information about the customers and Census Blocks, including the serving tower ID. The FDR file contains information about the serving tower and the backhaul components.

Cost Model Processing

Site Design and Investment

With the CostQuest Wireless® topology/design complete, the model uses a uniform design set of equipment and investment components for developing costs associated with the deployment of wireless coverage at each site. Since the model incorporates the use of owned and leased infrastructure (e.g., existing tower locations assumed to be available for commercial lease) via data or through a user provided input, certain equipment or investment may not be necessary at a site, and instead operational costs of a lease are captured. Following is a summary of the key components used in wireless site design. The diagram below is a depiction of standard site equipment and structure components.

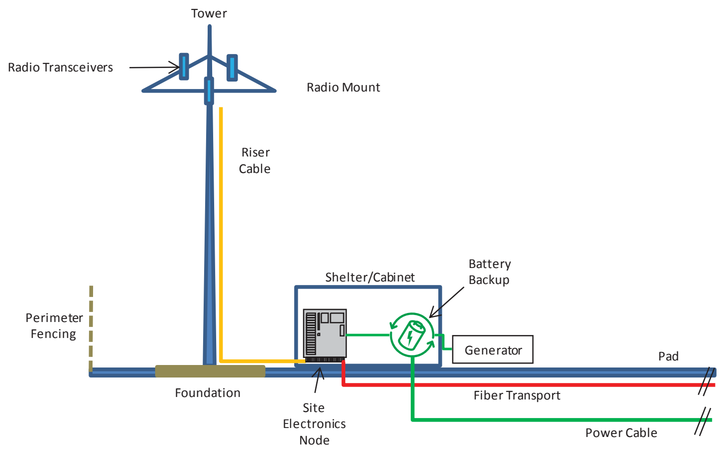


Figure 3--Typical site design

Radio Access Network (RAN)

This investment category incorporates site costs specific to the radio access function. Equipment in this category includes site based radio control, antenna costs, antenna cabling, radio frequency (RF) engineering and optimization.

The RAN investment model prepared for T-Mobile is based on industry estimates for a new site build of $300,000 and an augmentation site investment of $130,000. These industry estimated RAN site investments can be customized and developed using a bottom-up approach. The RAN sub-categories typically included in the investment are discussed below.

Site:

Depending on tower site ownership (which is an input in the model), this investment category can incorporate site costs specific to the investment in site acquisition (search services, lease negotiations, permitting), site development services (design, project management), site readiness (testing and inspection), and leasehold improvements (e.g., clearing, ground preparation, equipment pad, fencing, etc.).

Tower Structure:

Depending on ownership (which is an input in the Model), this investment category can incorporate site costs specific to the investment in the tower structure (e.g., a monopole or a lattice tower) equipment, as well as the cost to deliver and install the structure components. Also included in this category, on an as needed basis, are equipment and installation costs for tower lighting and antenna frames.

Antennas:

This is the investment for antennas that will be mounted on RAN site towers and other site structure (e.g., rooftop). The type and quantity of antennas used at a site is a function of the demand at the site and the spectrum available to serve the site. All sites will have one or more antennas.

Cabling:
This is the investment to connect antennas with site electronics. These cables carry the transmissions from the antenna locations to the site base station or Node B. Cabling is installed at all sites and its investment is driven by the distance (or structure height) from the base station to the antenna(s) and is also impacted by the number of antennas used at a site.

Electronics Node:
This is typically a cabinet or electronics shelf containing the active control electronics for the site. It will typically include radio frequency transmitters and receivers used to communicate with user devices, printed circuit boards ('cards') for processing user sessions, radio filters and amplifiers. For the purpose of this valuation, electronics nodes associated with LTE technology are referred to as an 'eNodeB.' One or more electronics node is located at each site.

Power:
This includes all investment to connect, provide, and convert power to run a site. There are three subcategories of power: i) Integration is the investment to connect power sources (commercial and back-up) to the site electronics requiring the power. This will include power cables as well as rectifiers and converters to condition the power so it is suitable for the different electronic components used at a site. All sites require power integration. ii) Battery is the investment in battery technology used as back-up in the event of a commercial power failure. For the purpose of this valuation, all sites have some amount of battery back-up. iii) Generator is the investment in a portable or fixed fossil fuel power generator used as back-up in the event of a commercial power failure.

Backhaul:
This is the investment required to connect the site with the rest of the network. For the purpose of this valuation, as noted earlier, the current model assumes that landline backhaul is leased and is loaded in as an operational cost. Microwave investments are loaded as the average across all towers.

Network Core Design and Investment
For the purpose of the Model, the core network functionality and associated investment is based on user input. Currently, the value is based on a value derived from industry data.

Operating Expense Input Development (Opex)

Operational expenses of an efficient provider were based on publicly available expenses and financial data, which (when aggregated and calculated) illustrate an industry average.

In order to allocate operational expense in the context of the model, expense values were apportioned based on logical cost associations or "drivers." The following table shows the apportionment basis for each expense category.

Classification	Category	Sub Category	Apportionment Driver
Cost of Service	Cell Site Operations & Maintenance	Network Operations - Site Repair & Maintenance	Cell Site
Cost of Service	Cell Site Operations & Maintenance	Cell Site Rental	Cell Site
Cost of Service	Transport	Fixed Transport - Leased Direct (Backhaul)	Cell Site
Cost of Service	Utilities	Power & Fuel	Cell Site
Cost of Service	Usage	Local Call Termination (Net Reciprocal Compensation)	All Subscribers
Cost of Service	Usage	Long Distance	All Subscribers
Cost of Service	Usage	Data Content	All Subscribers
Cost of Service	Roaming	Net Domestic (In - Out)	All Subscribers
SG&A	General & Administrative Operating Expense per Subscriber		All Subscribers
SG&A	Corporate Marketing and Advertising	Allocated Corporate Marketing	All Subscribers
SG&A	Other - Bad Debt		All Subscribers
SG&A	Customer Accquisition Costs (excluding subsidy) per New Subscriber		All Subscribers
SG&A	Equipment Subsidy per New Subscriber		All Subscribers

The Apportionment Driver data value was divided into the annual cost for the Category to render a unitized value for use as model input.

Leased or Owned Site Indexing Development

Objective:
Identify and incorporate cost variances associated with cell sites that are owned and cell sites that are leased to derive investment appropriately related to each and derive a factor to be used as an estimate on the proportion of new sites that will be built or leased in urban, suburban, and rural areas.

Approach:
Utilize 'owned' or 'leased' categorization of sites by market density type to determine the relative mix as a benchmark for the propensity to own or lease a site. These factors are then applied to determine the appropriate costing of sites in the Model.

Categorization	Rural	Suburban	Urban
Own	60	40	20
Lease	40	60	80

Results

We performed a complete comparative analysis for fifteen states. The modeling and the resulting output was developed for Arizona, Colorado, Florida, Georgia, Hawaii, Idaho, Kentucky, Louisiana, Minnesota, Mississippi, North Carolina, New Mexico, Oregon, Texas, and Washington. These states were chosen as they offer varying topographies and population densities as well as engaged state regulatory commissions. The reported results represent a support model scenario that uses the following parameters:

- The model uses a single network deploying mobile broadband to levelized (over 6 years) demand of 60% for consumers and 32% for businesses.

- The model assumes an Average Revenue per User (ARPU) benchmark of $49. Costs below this amount are not funded.
- The Model includes a threshold for funding (funding cap) at $250 per month. This means that census blocks requiring a monthly support level in excess of $250 per user would not be funded.
- As part of the two state analyses, we are assuming costs of just one provider's network.

The model results show a stark difference between the 700MHz investment and the 1900MHz investment. On average, across all fifteen states, the model shows that the 1900MHz build requires nearly 300% more in total investment. The following schedule summarizes the results by state.

Total Est. Annual Funding Needed			
	700MHz	**1900MHz**	***% Difference***
Arizona	$19,241,557	$57,752,708	***200%***
Colorado	$16,659,640	$58,559,001	***252%***
Florida	$1,721,422	$9,458,345	***449%***
Georgia	$5,147,021	$39,242,541	***662%***
Hawaii	$521,517	$1,610,316	***209%***
Idaho	$15,195,767	$38,089,762	***151%***
Kentucky	$591,039	$13,048,924	***2108%***
Louisiana	$442,023	$8,819,237	***1895%***
Minnesota	$2,994,023	$32,475,339	***985%***
Mississippi	$1,497,479	$12,153,013	***712%***
North Carolina	$2,491,848	$25,037,044	***905%***
New Mexico	$20,123,991	$32,475,339	***61%***
Oregon	$17,675,756	$53,855,778	***205%***
Texas	$18,563,022	$79,178,026	***327%***
Washington	$9,348,960	$38,924,421	***316%***
All States	*$132,215,066*	*$500,679,793*	***279%***

Further detail on the results for each state, including maps, can be found below.

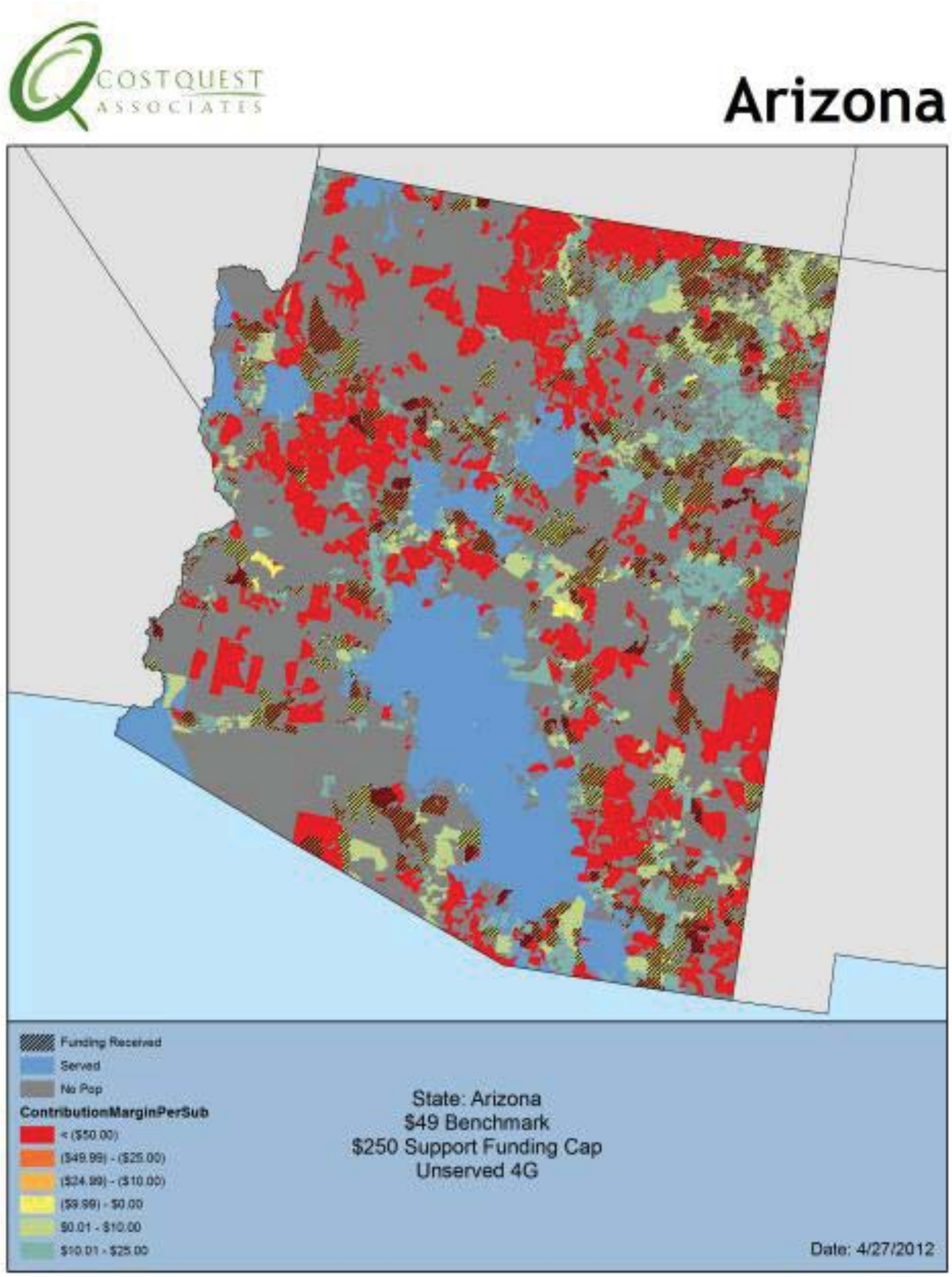
Definitions:

Total Subscribers – Total subscribers in 4G unserved areas across the state
Funded Subscribers (Costs Exceed ARPU) – Total number of subscribers funded in the model scenario
Total Funding (Required Monthly Funding) – Total amount of funding needed per month
Avg. Monthly Cost/ (per funded subs) – Average of funding for subscribers funded
Avg. Monthly Cost/ (per total subs) – Average of funding for ALL (funded or unfunded) subscribers in 4G unserved areas

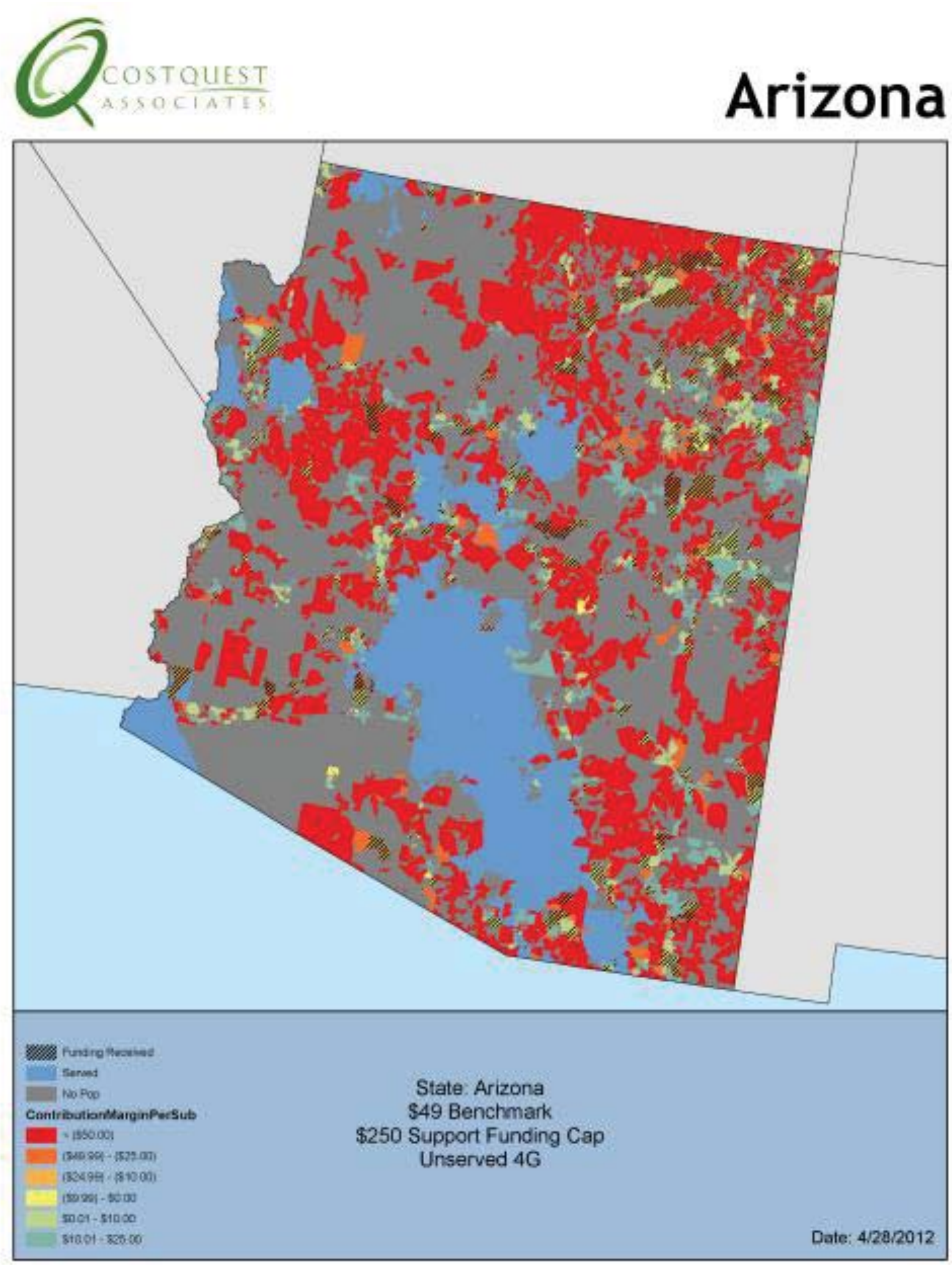
Model Results for Arizona

Arizona - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	494,130	494,130	0%
Funded Subscribers (Costs Exceed ARPU)	35,698	54,761	53%
Total Funding (Required Monthly Funding)	$1,603,463	$4,812,726	200%
Average Monthly Subsidy/(per funded sub)	$38	$50	32%
Average Monthly Cost/(per total subs)	$41	$55	34%
Total Annual Modeled Funding =	**$19,241,557**	**$57,752,708**	**200%**

Arizona Maps - 700MHz Contribution Margin Map



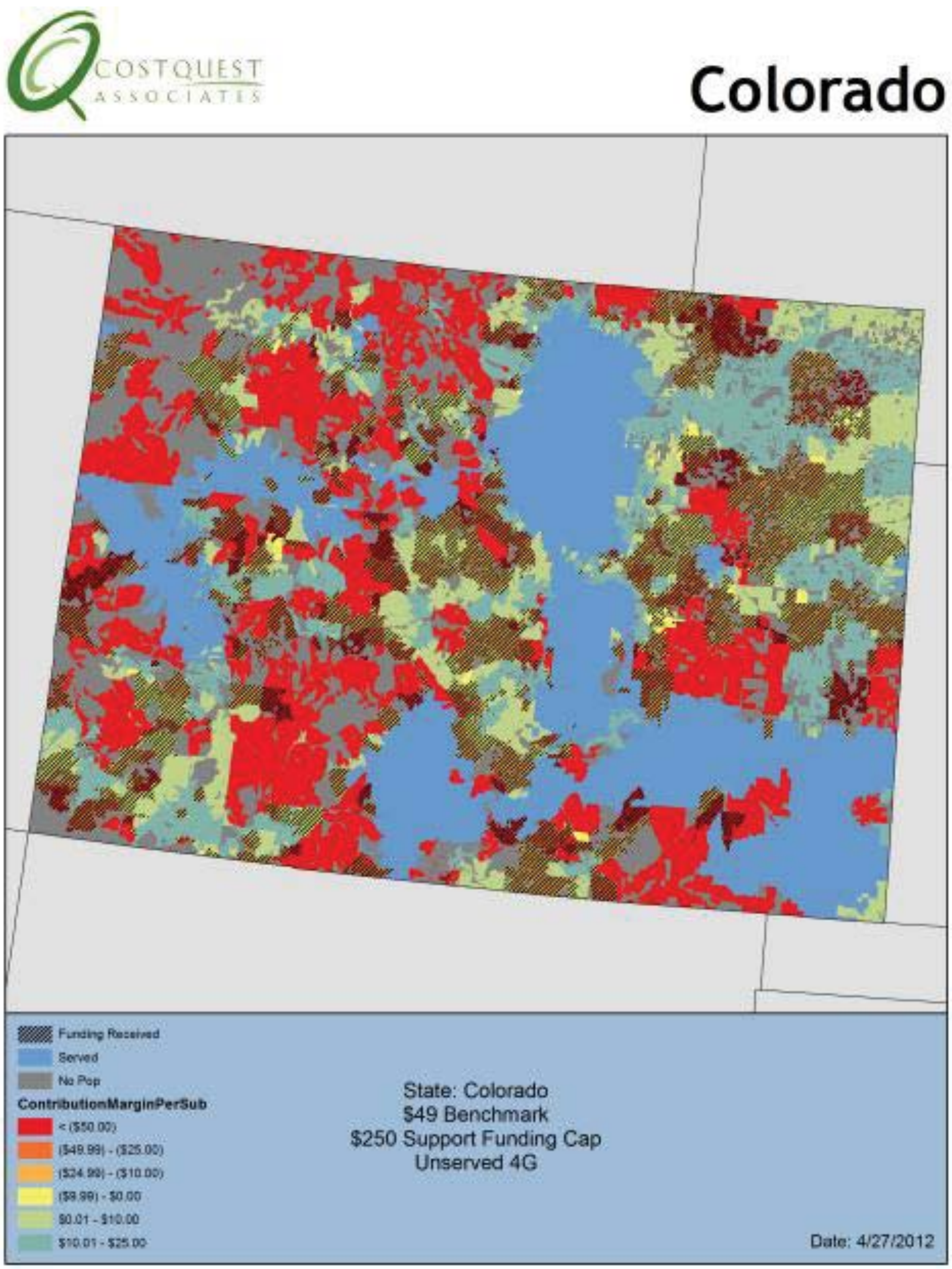
Arizona Maps - 1900MHz Contribution Margin Map



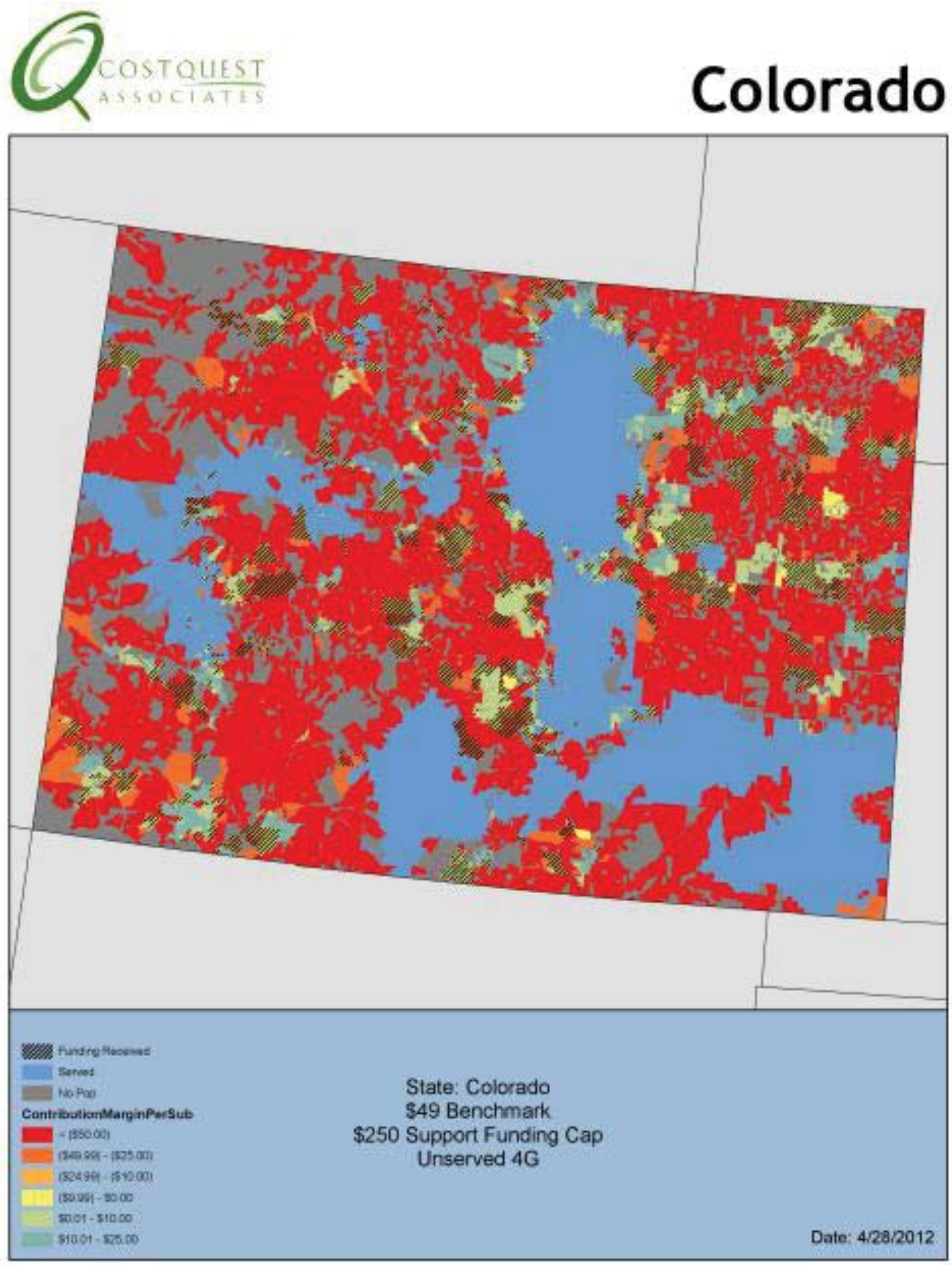
Model Results for Colorado

Colorado - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	364,039	364,039	0%
Funded Subscribers (Costs Exceed ARPU)	35,546	51,180	44%
Total Funding (Required Monthly Funding)	$1,388,303	$4,879,917	252%
Average Monthly Subsidy/(per funded sub)	$34	$52	53%
Average Monthly Cost/(per total subs)	$42	$61	45%
Total Annual Modeled Funding =	**$16,659,640**	**$58,559,001**	**252%**

Colorado Maps - 700MHz Contribution Margin Map



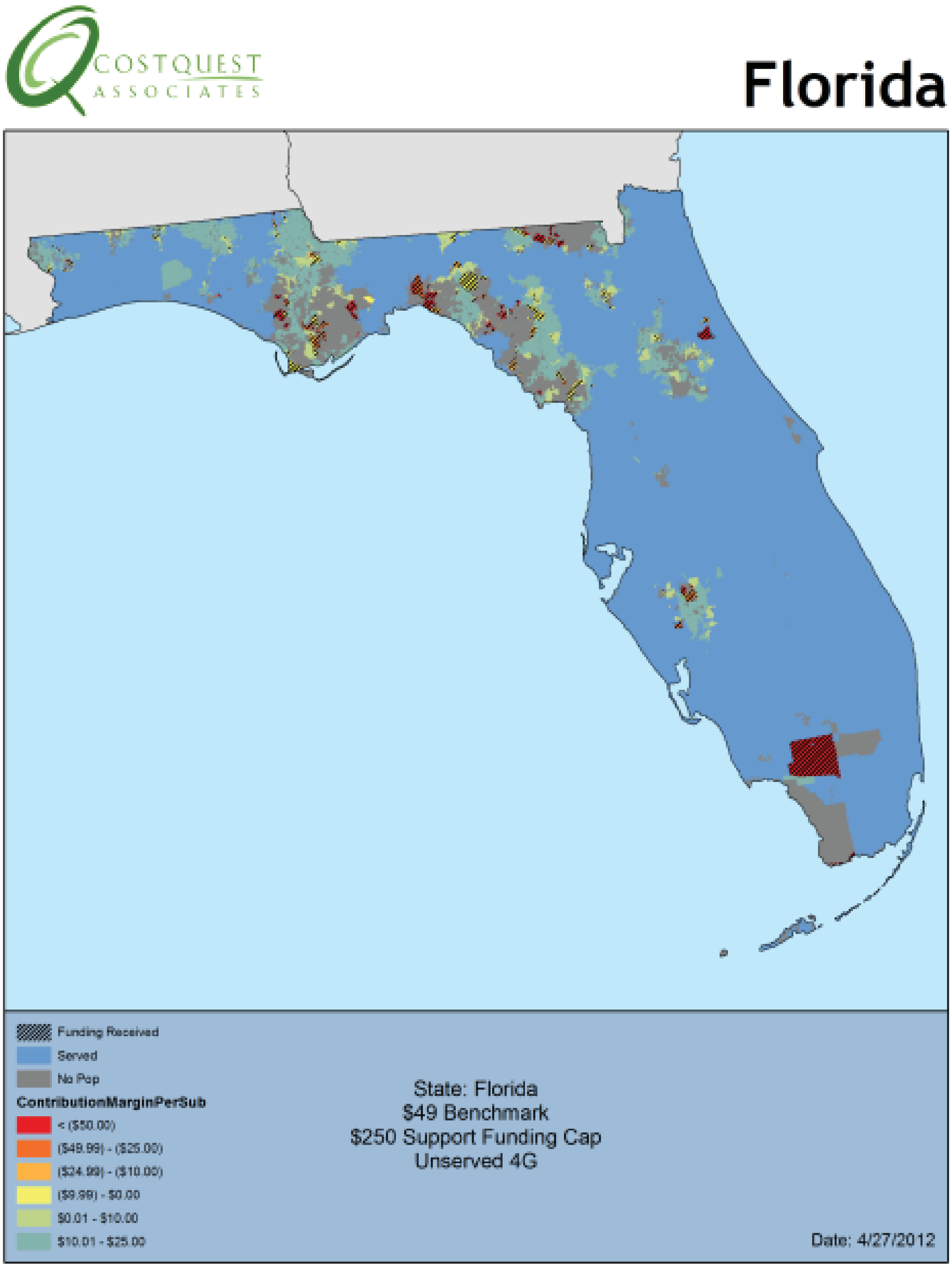
Colorado Maps - 1900MHz Contribution Margin Map



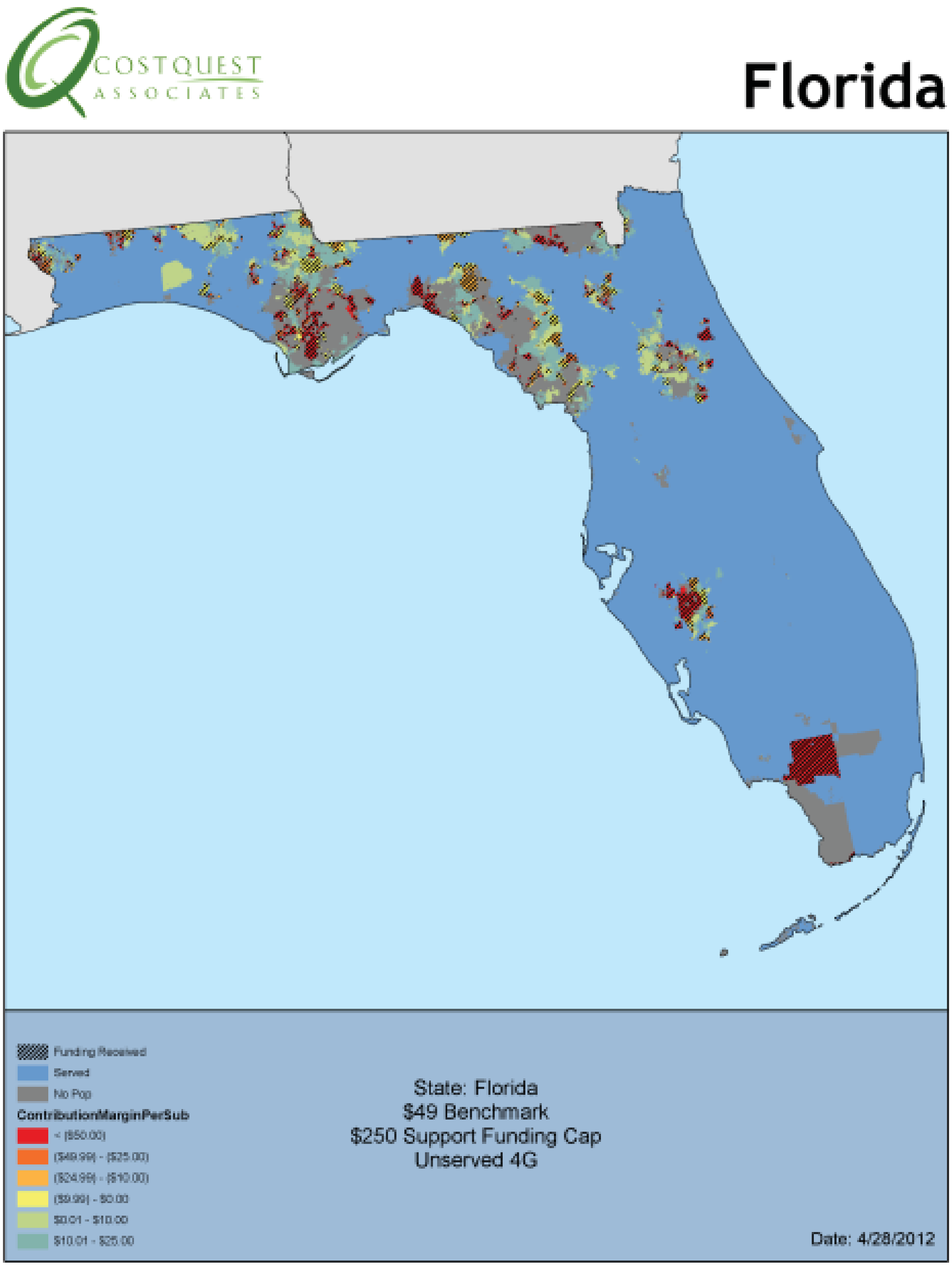
Model Results for Florida

Florida - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	233,593	233,593	0%
Funded Subscribers (Costs Exceed ARPU)	5,912	34,632	486%
Total Funding (Required Monthly Funding)	$143,452	$788,195	449%
Average Monthly Subsidy/(per funded sub)	$24	$23	-6%
Average Monthly Cost/(per total subs)	$36	$43	20%
Total Annual Modeled Funding =	**$1,721,422**	**$9,458,345**	**449%**

Florida Maps - 700MHz Contribution Margin Map



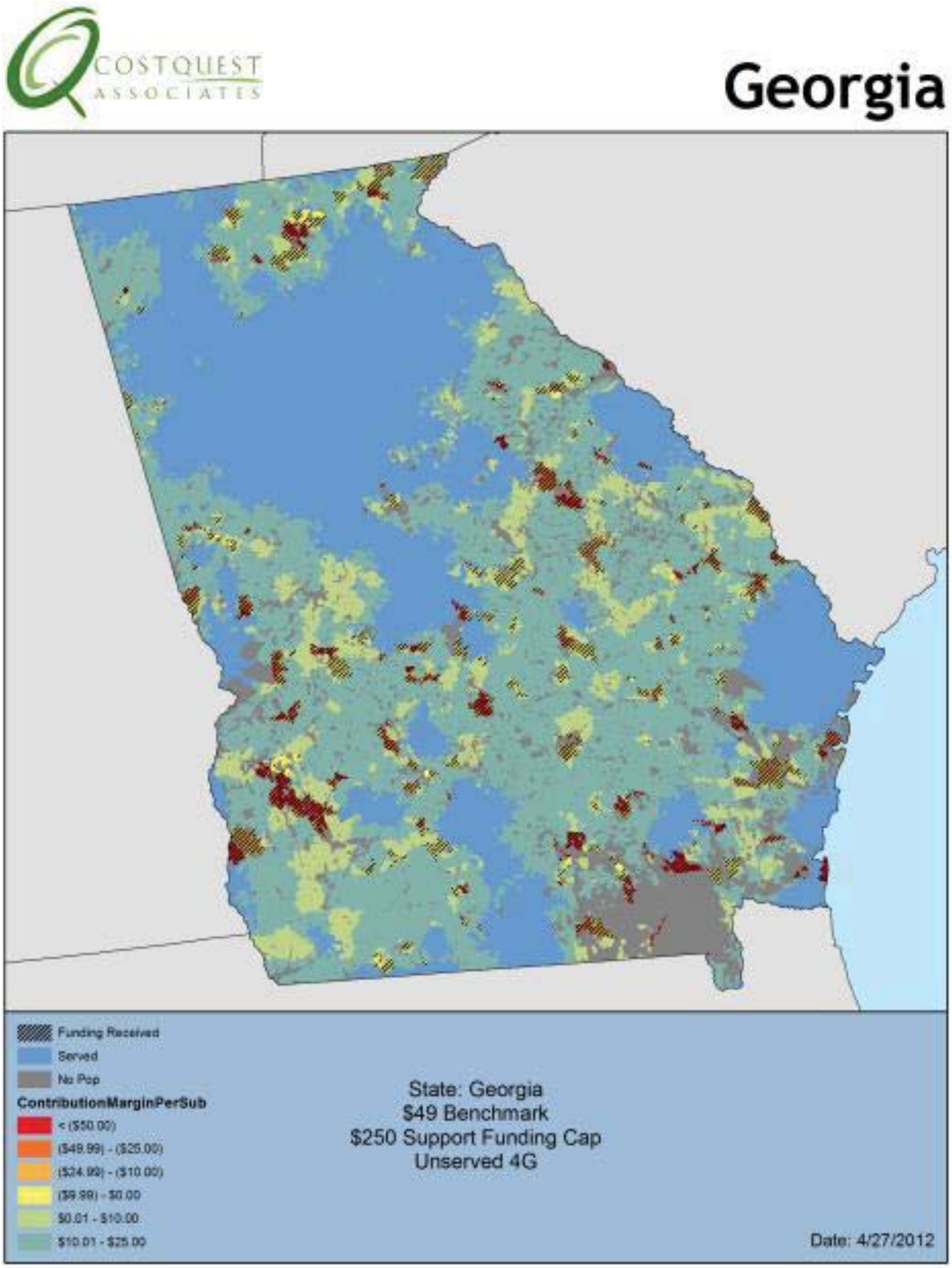
Florida Maps - 1900MHz Contribution Margin Map



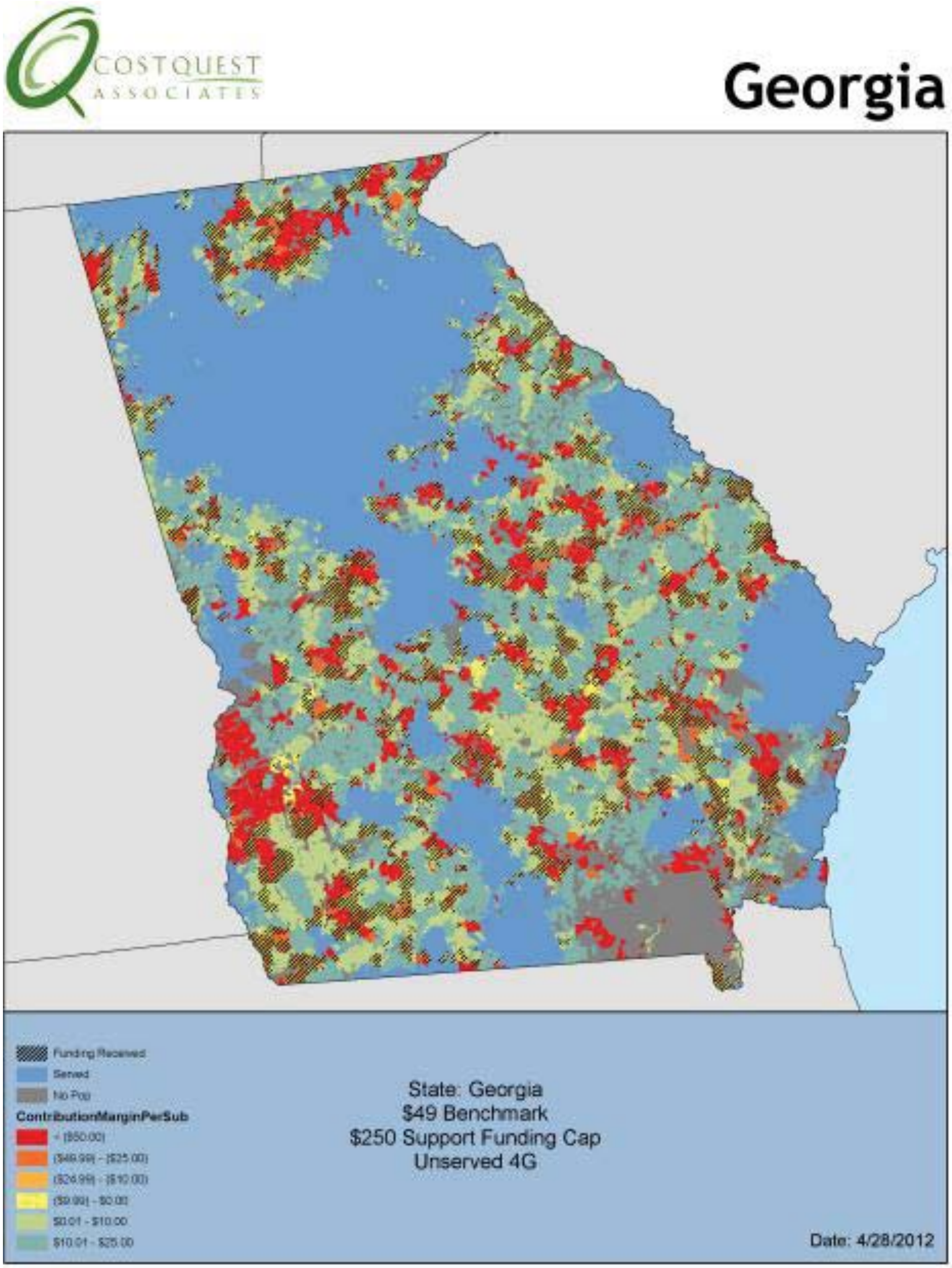
Model Results for Georgia

Georgia - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	1,077,994	1,078,037	0%
Funded Subscribers (Costs Exceed ARPU)	23,318	122,313	425%
Total Funding (Required Monthly Funding)	$428,918	$3,270,212	662%
Average Monthly Subsidy/(per funded sub)	$18	$22	17%
Average Monthly Cost/(per total subs)	$36	$42	17%
Total Annual Modeled Funding =	**$5,147,021**	**$39,242,541**	**662%**

Georgia Maps - 700MHz Contribution Margin Map



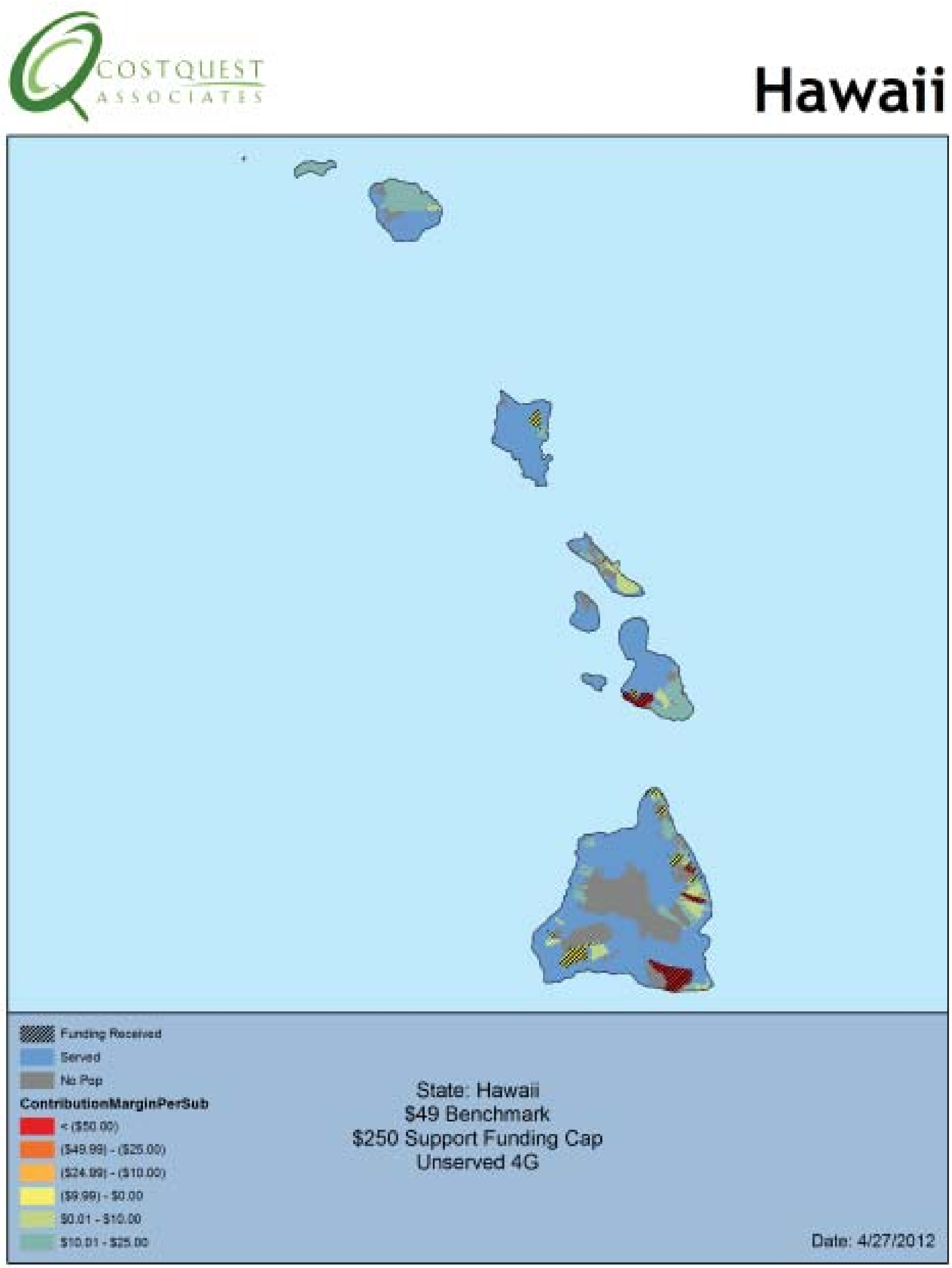
Georgia Maps - 1900MHz Contribution Margin Map



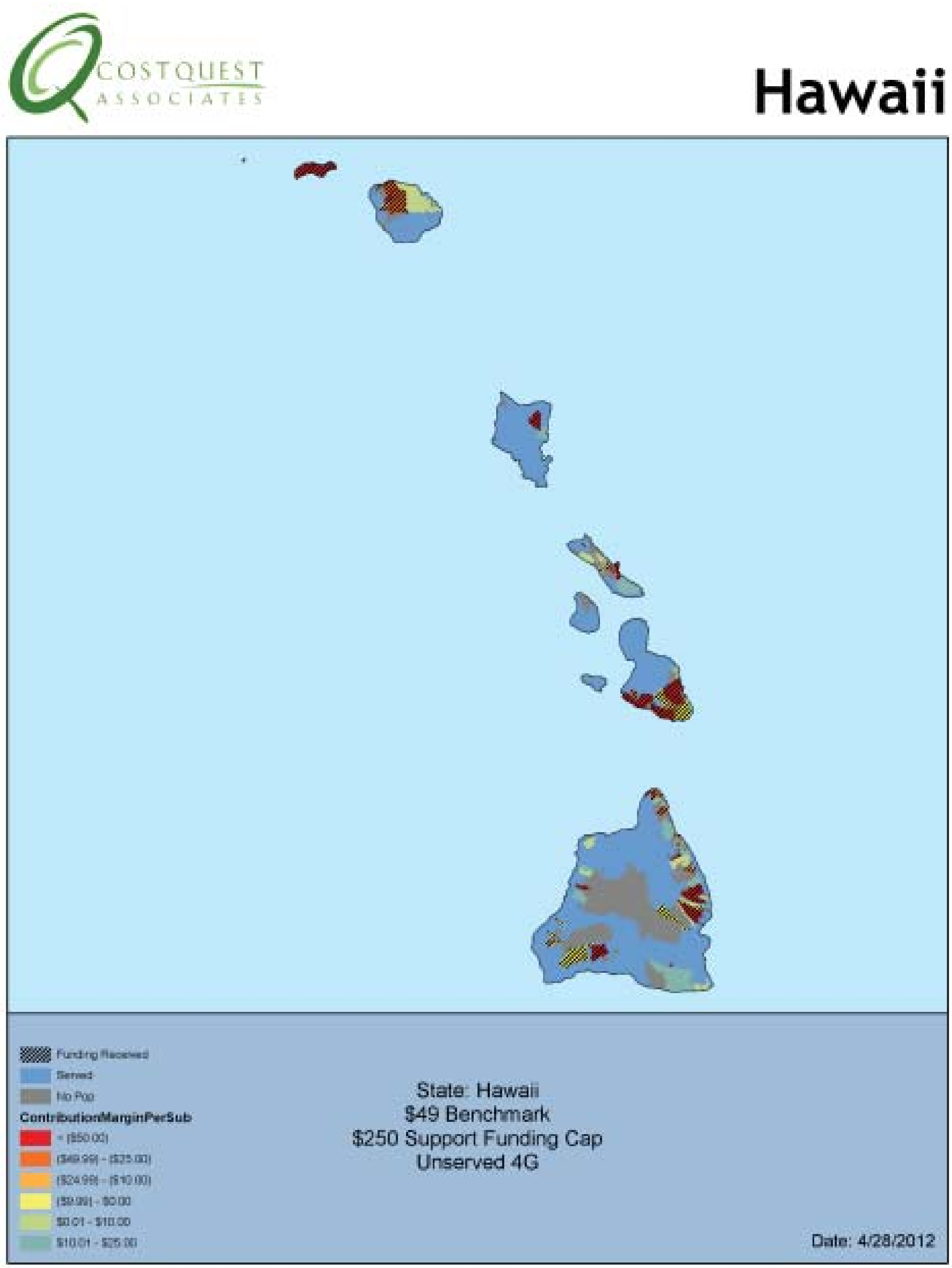
Model Results for Hawaii

Hawaii - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	29,771	29,771	0%
Funded Subscribers (Costs Exceed ARPU)	1,740	5,239	201%
Total Funding (Required Monthly Funding)	$43,460	$134,193	209%
Average Monthly Subsidy/(per funded sub)	$25	$26	3%
Average Monthly Cost/(per total subs)	$39	$46	16%
Total Annual Modeled Funding =	**$521,517**	**$1,610,316**	**209%**

Hawaii Maps - 700MHz Contribution Margin Map



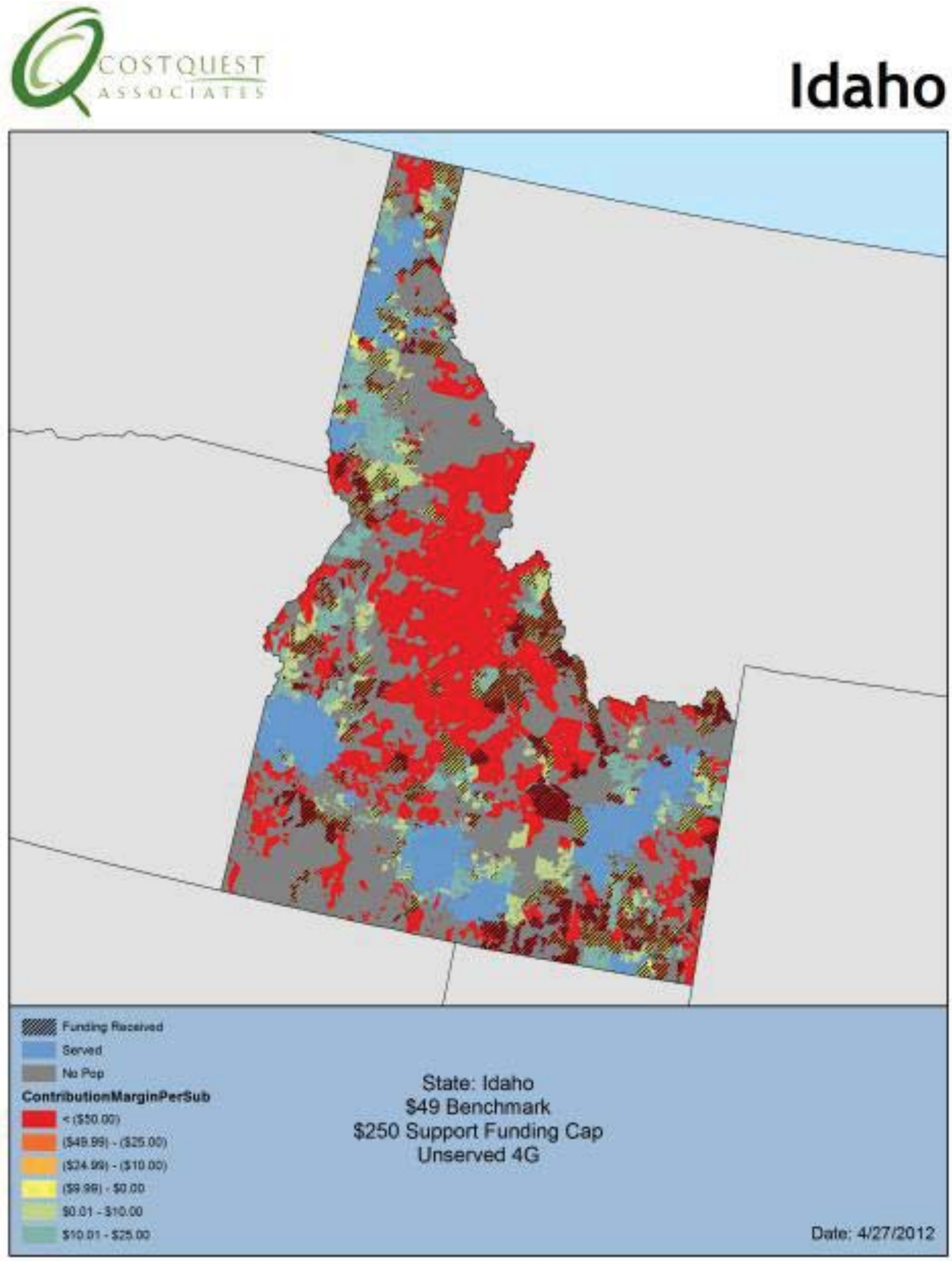
Hawaii Maps - 1900MHz Contribution Margin Map



Model Results for Idaho

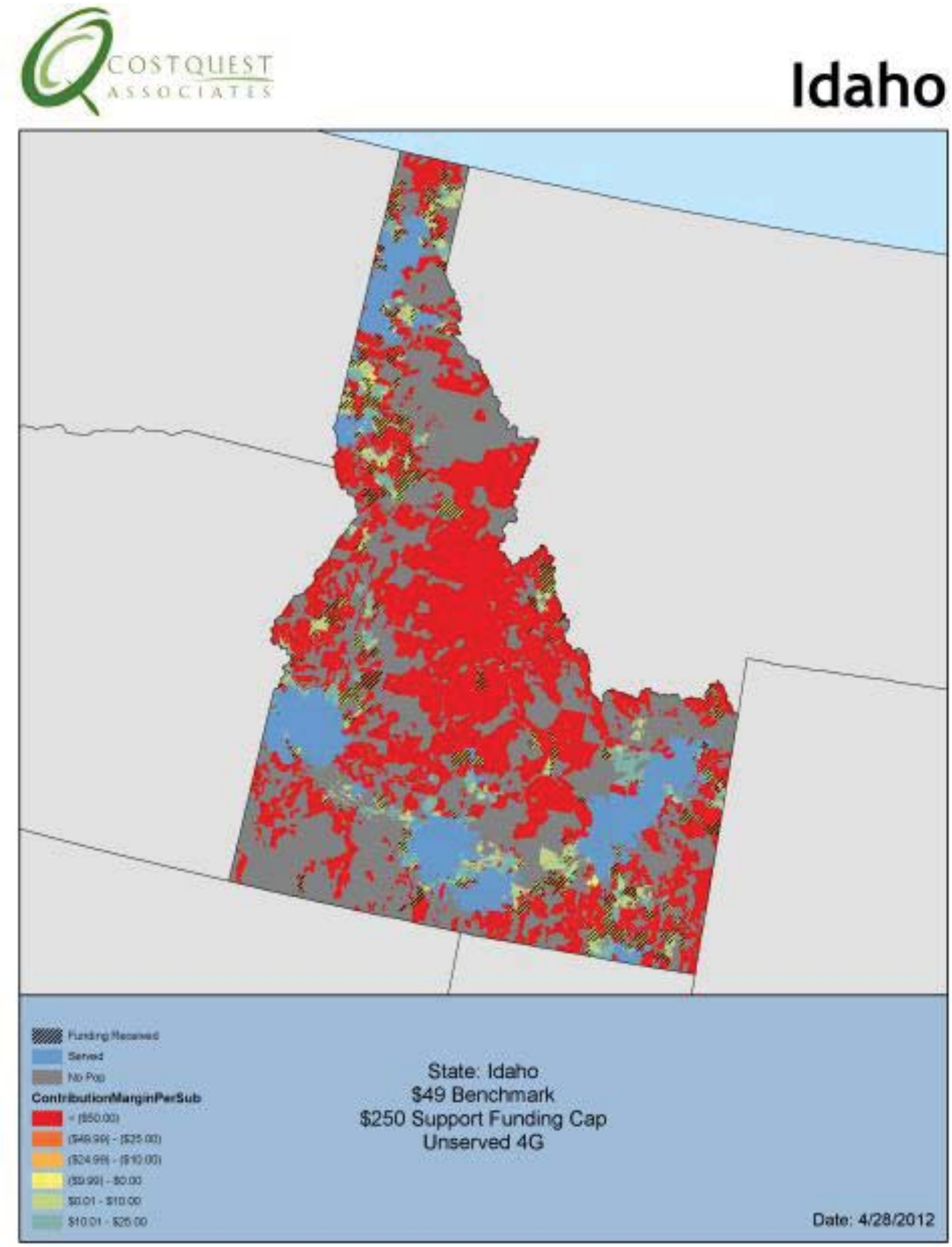
Idaho - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	221,426	221,426	0%
Funded Subscribers (Costs Exceed ARPU)	25,121	42,362	69%
Total Funding (Required Monthly Funding)	$1,266,314	$3,174,147	151%
Average Monthly Subsidy/(per funded sub)	$45	$50	13%
Average Monthly Cost/(per total subs)	$47	$70	48%
Total Annual Modeled Funding =	**$15,195,767**	**$38,089,762**	**151%**

Idaho Maps - 700MHz Contribution Margin Map



COSTQUEST
ASSOCIATES

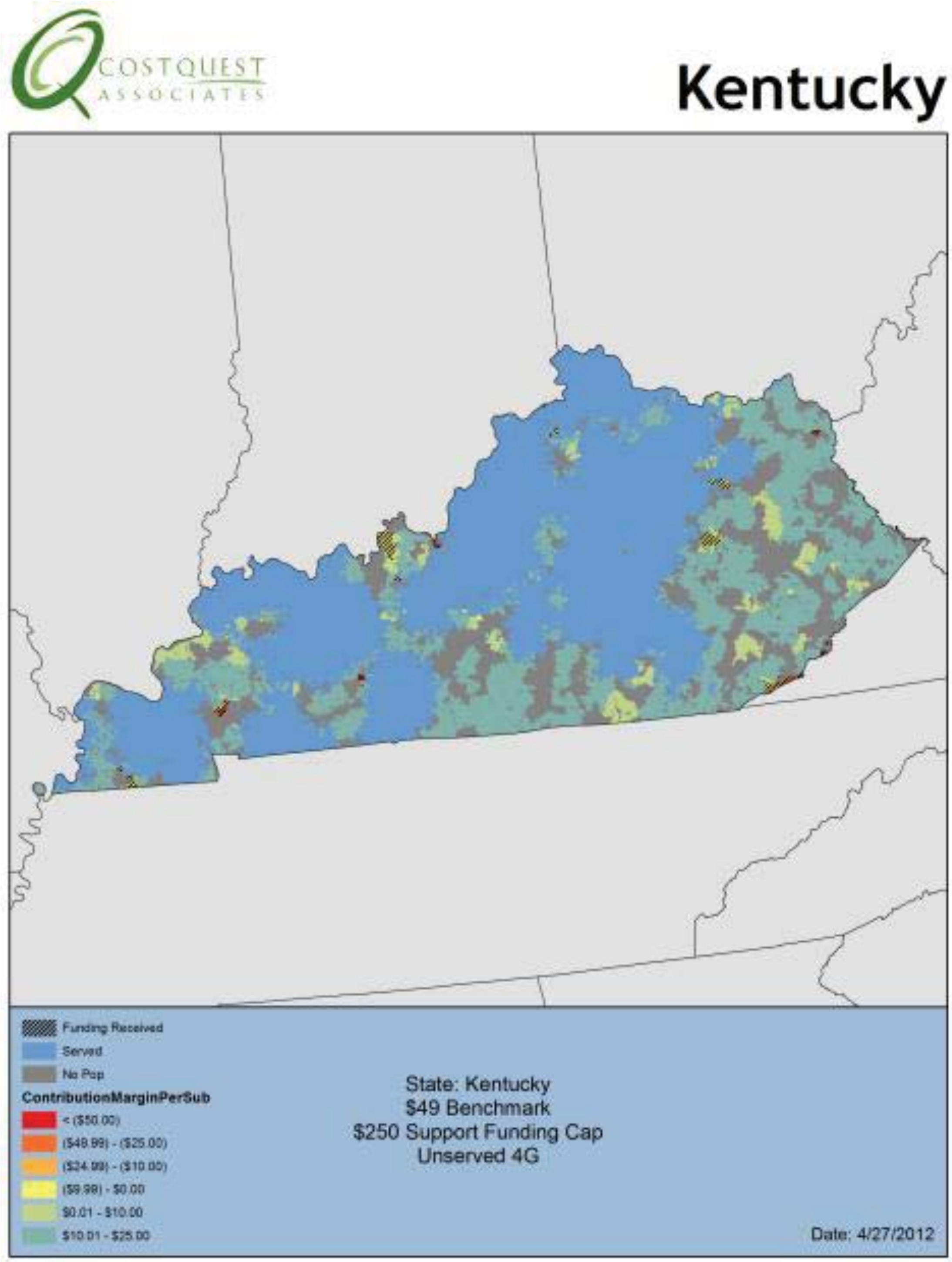
Idaho Maps - 1900MHz Contribution Margin Map



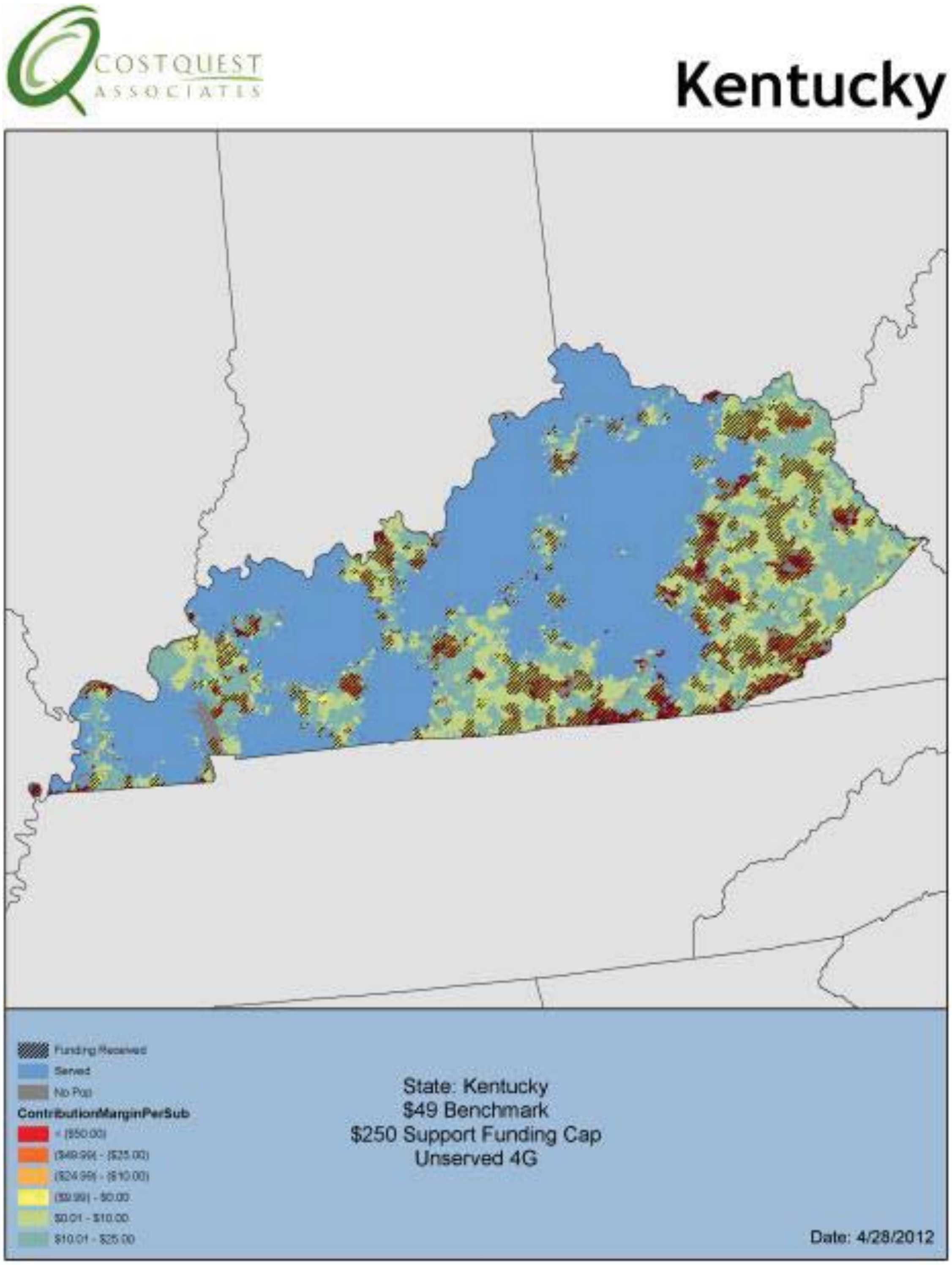
Model Results for Kentucky

Kentucky - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	348,535	696,896	100%
Funded Subscribers (Costs Exceed ARPU)	2,220	85,324	3743%
Total Funding (Required Monthly Funding)	$49,253	$1,087,410	2108%
Average Monthly Subsidy/(per funded sub)	$22	$13	-43%
Average Monthly Cost/(per total subs)	$35	$41	17%
Total Annual Modeled Funding =	**$591,039**	**$13,048,924**	**2108%**

Kentucky Maps - 700MHz Contribution Margin Map



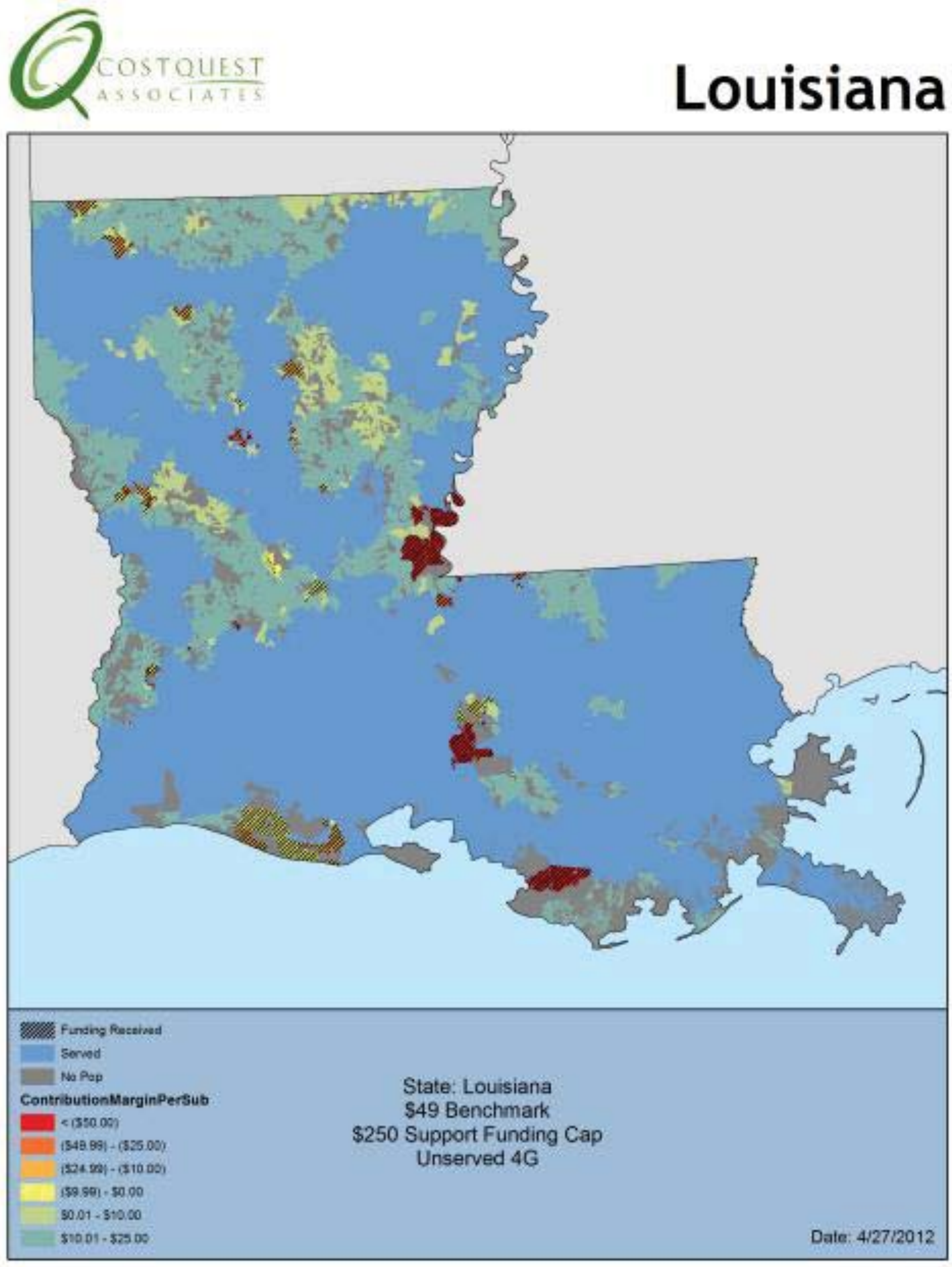
Kentucky Maps - 1900MHz Contribution Margin Map



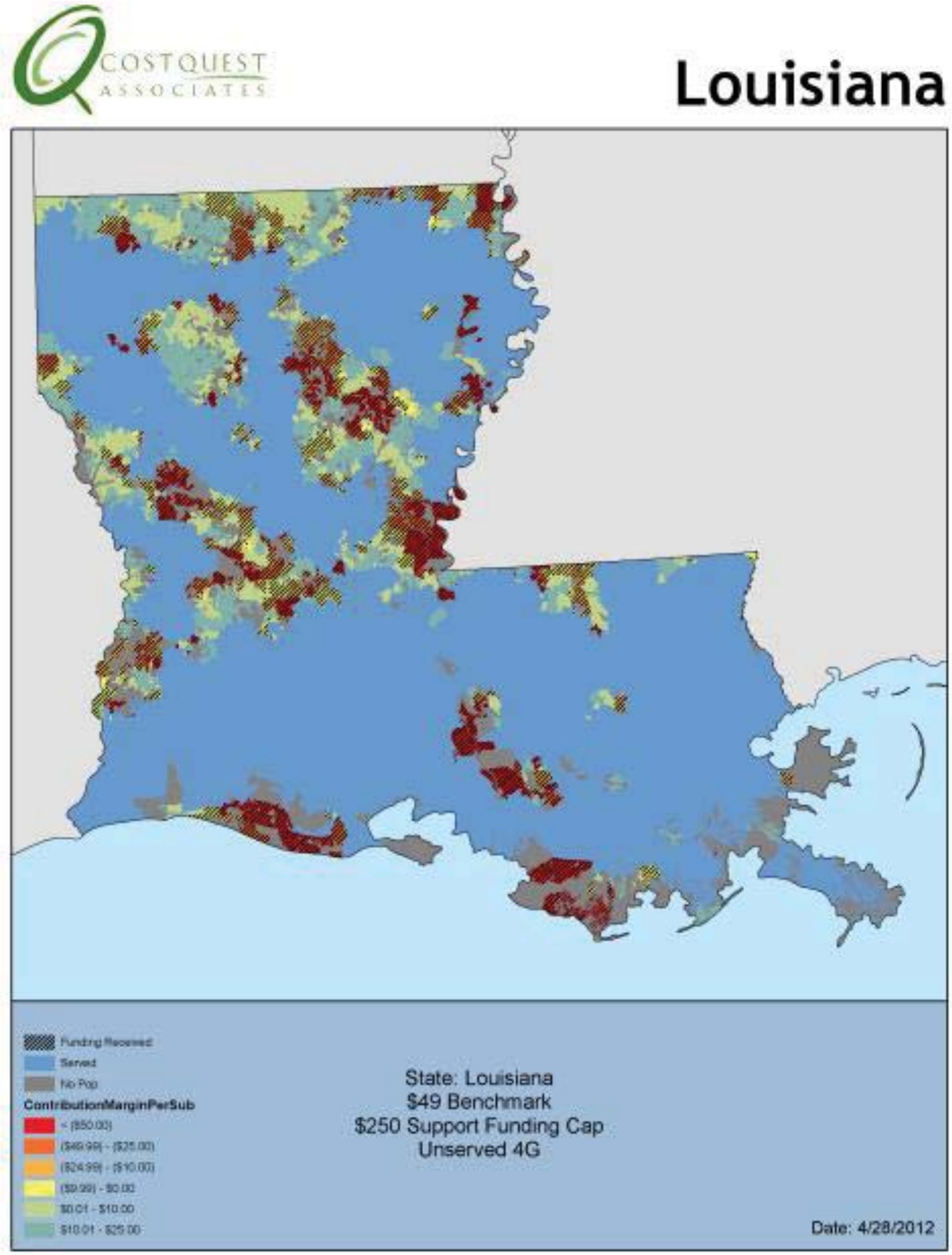
Model Results for Louisiana

Louisiana - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	180,009	180,021	0%
Funded Subscribers (Costs Exceed ARPU)	2,294	36,234	1480%
Total Funding (Required Monthly Funding)	$36,835	$734,936	1895%
Average Monthly Subsidy/(per funded sub)	$16	$20	26%
Average Monthly Cost/(per total subs)	$35	$45	27%
Total Annual Modeled Funding =	**$442,023**	**$8,819,237**	**1895%**

Louisiana Maps - 700MHz Contribution Margin Map



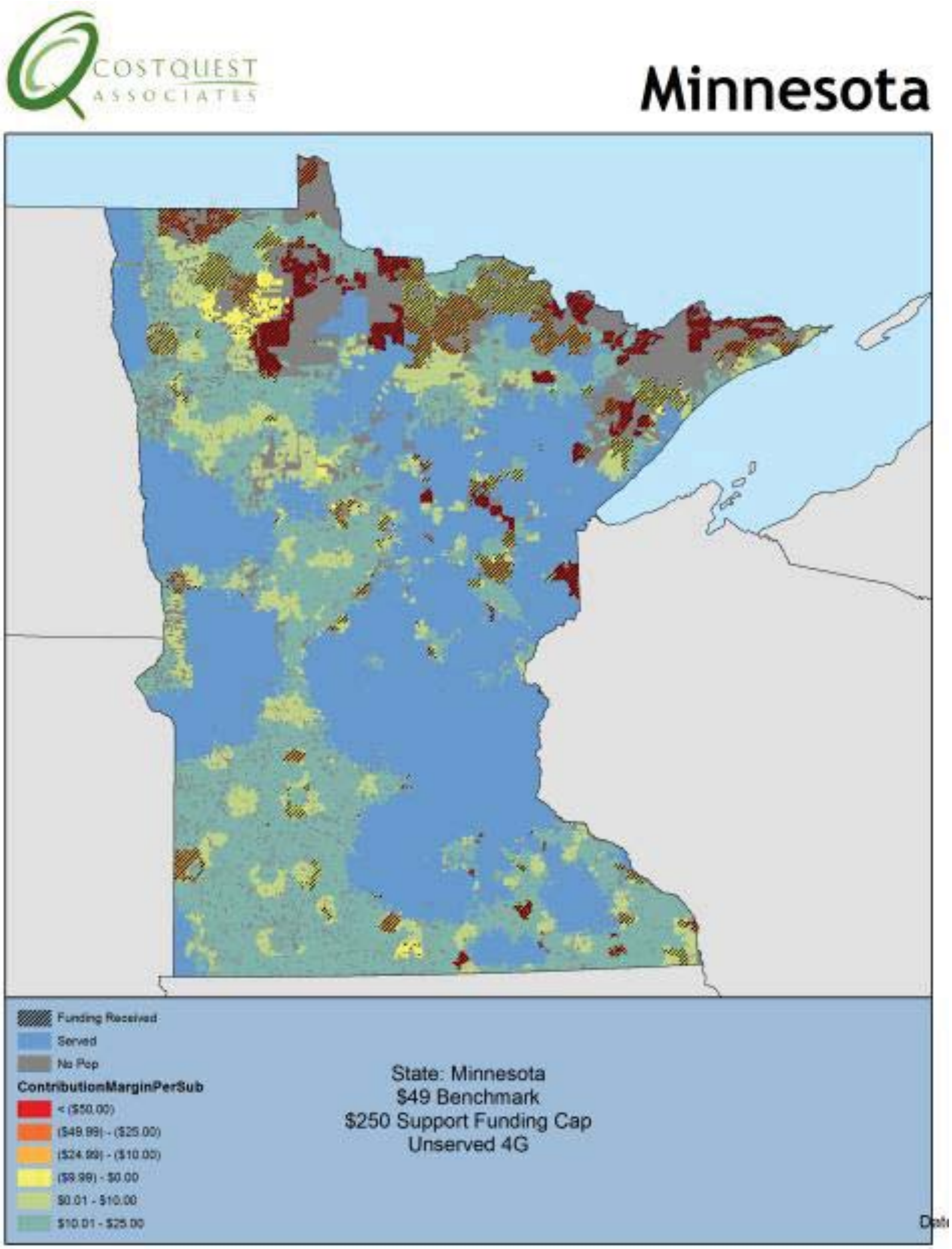
Louisiana Maps - 1900MHz Contribution Margin Map



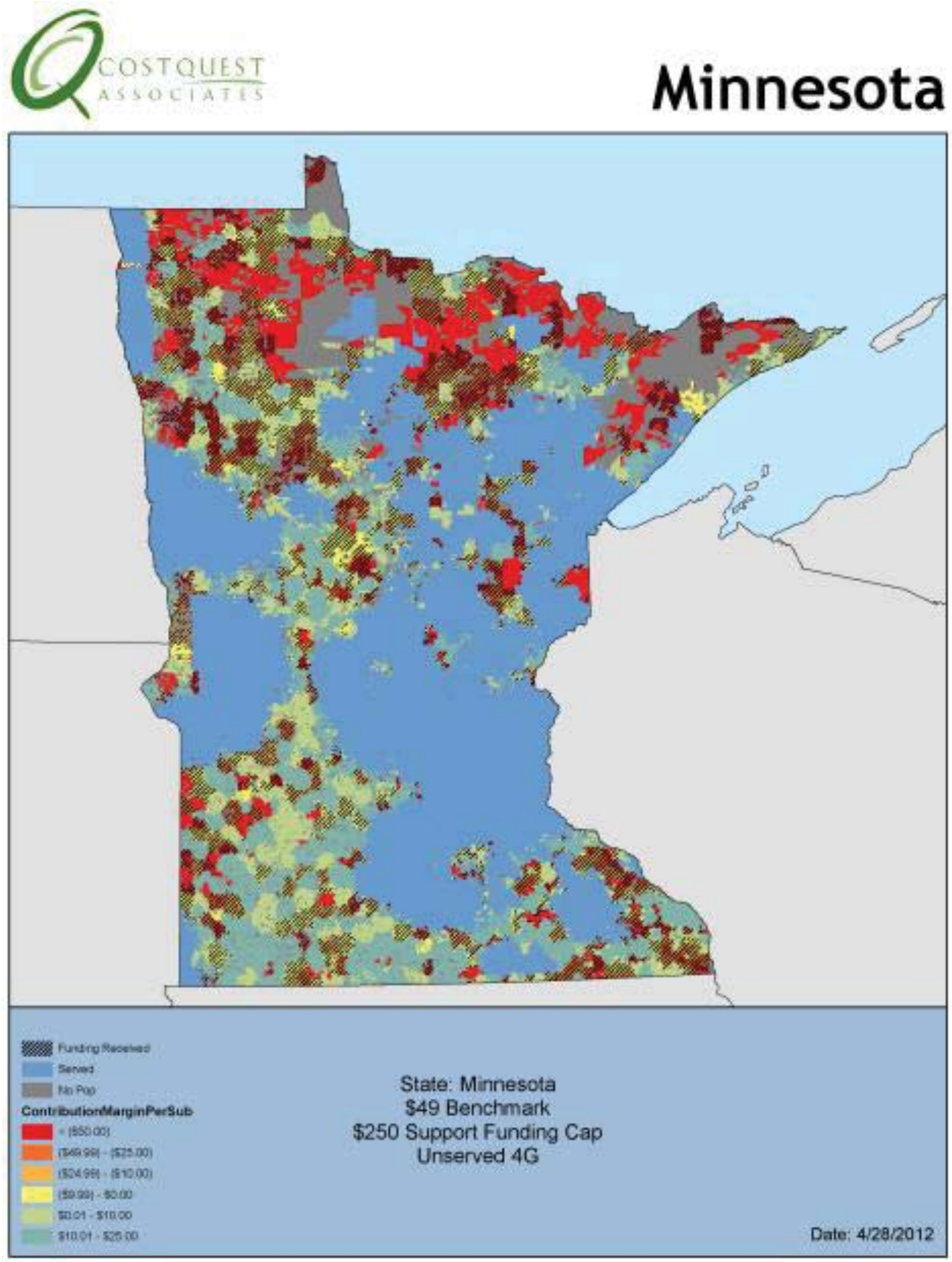
Model Results for Minnesota

Minnesota - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	622,369	622,559	0%
Funded Subscribers (Costs Exceed ARPU)	14,257	97,013	580%
Total Funding (Required Monthly Funding)	$249,502	$2,706,278	985%
Average Monthly Subsidy/(per funded sub)	$18	$26	48%
Average Monthly Cost/(per total subs)	$36	$44	21%
Total Annual Modeled Funding =	**$2,994,023**	**$32,475,339**	**985%**

Minnesota Maps - 700MHz Contribution Margin Map



Minnesota Maps - 1900MHz Contribution Margin Map

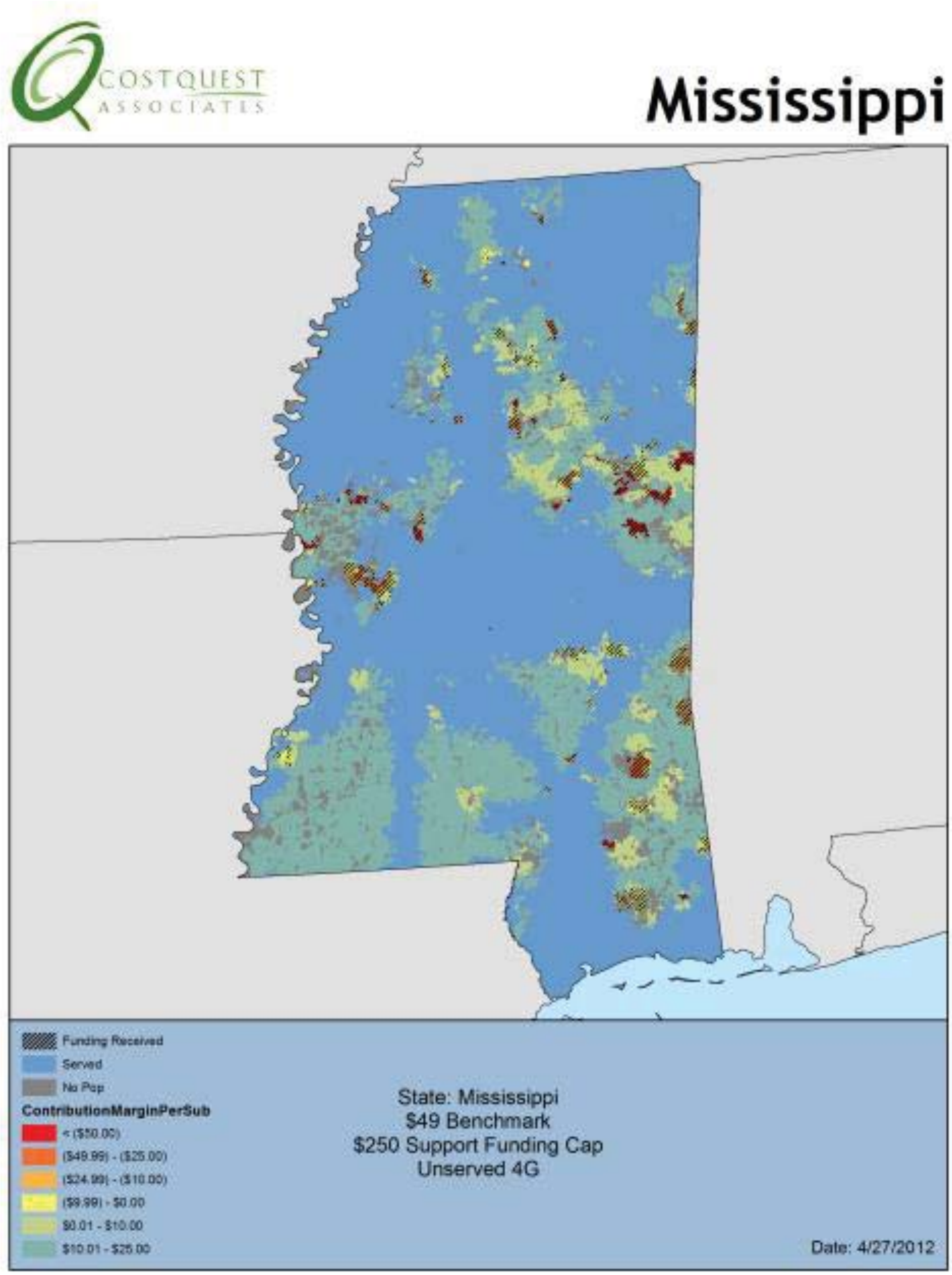


Model Results for Mississippi

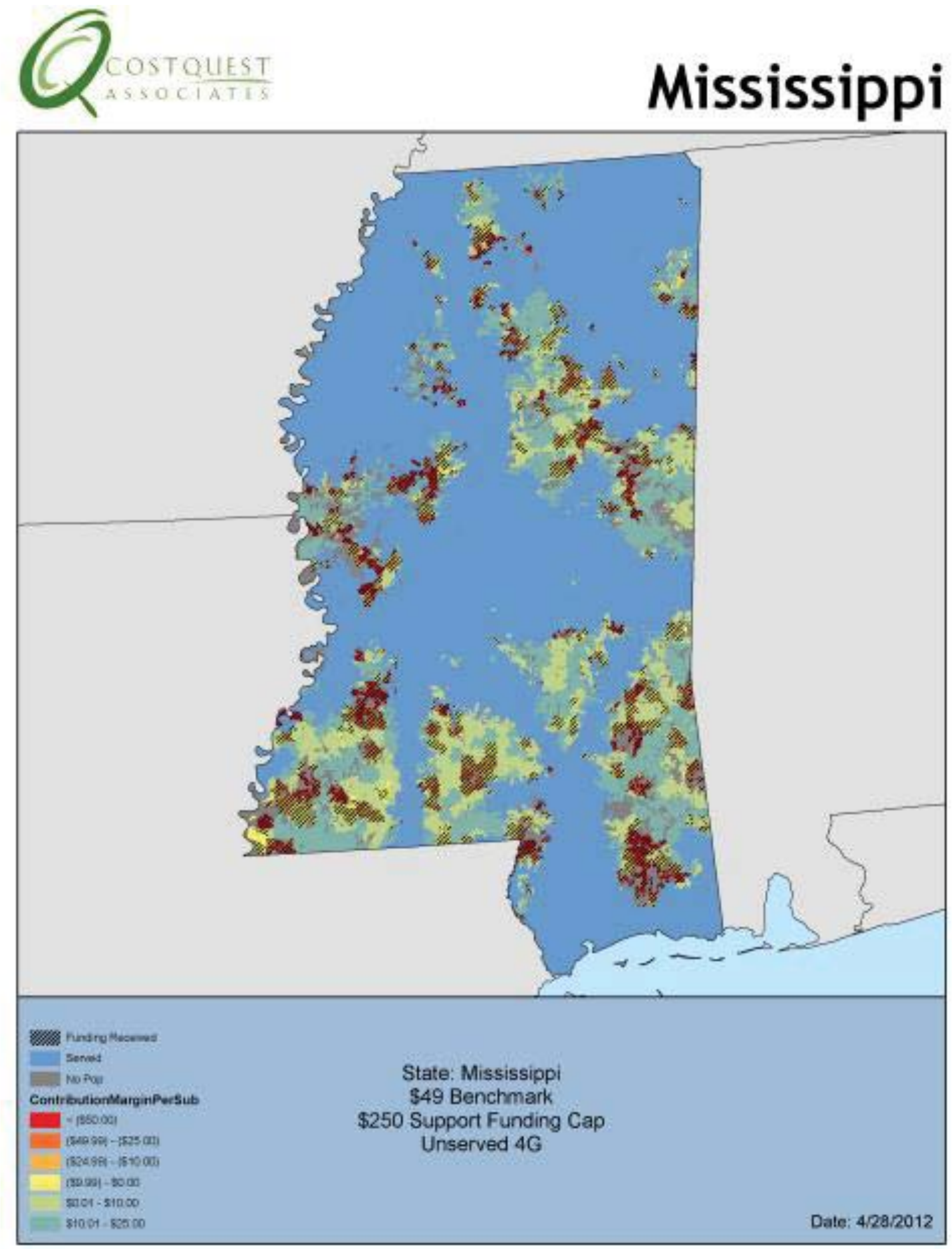
Mississippi - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	264,362	264,362	0%
Funded Subscribers (Costs Exceed ARPU)	6,125	52,937	764%
Total Funding (Required Monthly Funding)	$124,790	$1,012,751	712%
Average Monthly Subsidy/(per funded sub)	$20	$19	-6%
Average Monthly Cost/(per total subs)	$36	$45	23%
Total Annual Modeled Funding =	**$1,497,479**	**$12,153,013**	**712%**

COSTQUEST ASSOCIATES

Mississippi Maps - 700MHz Contribution Margin Map



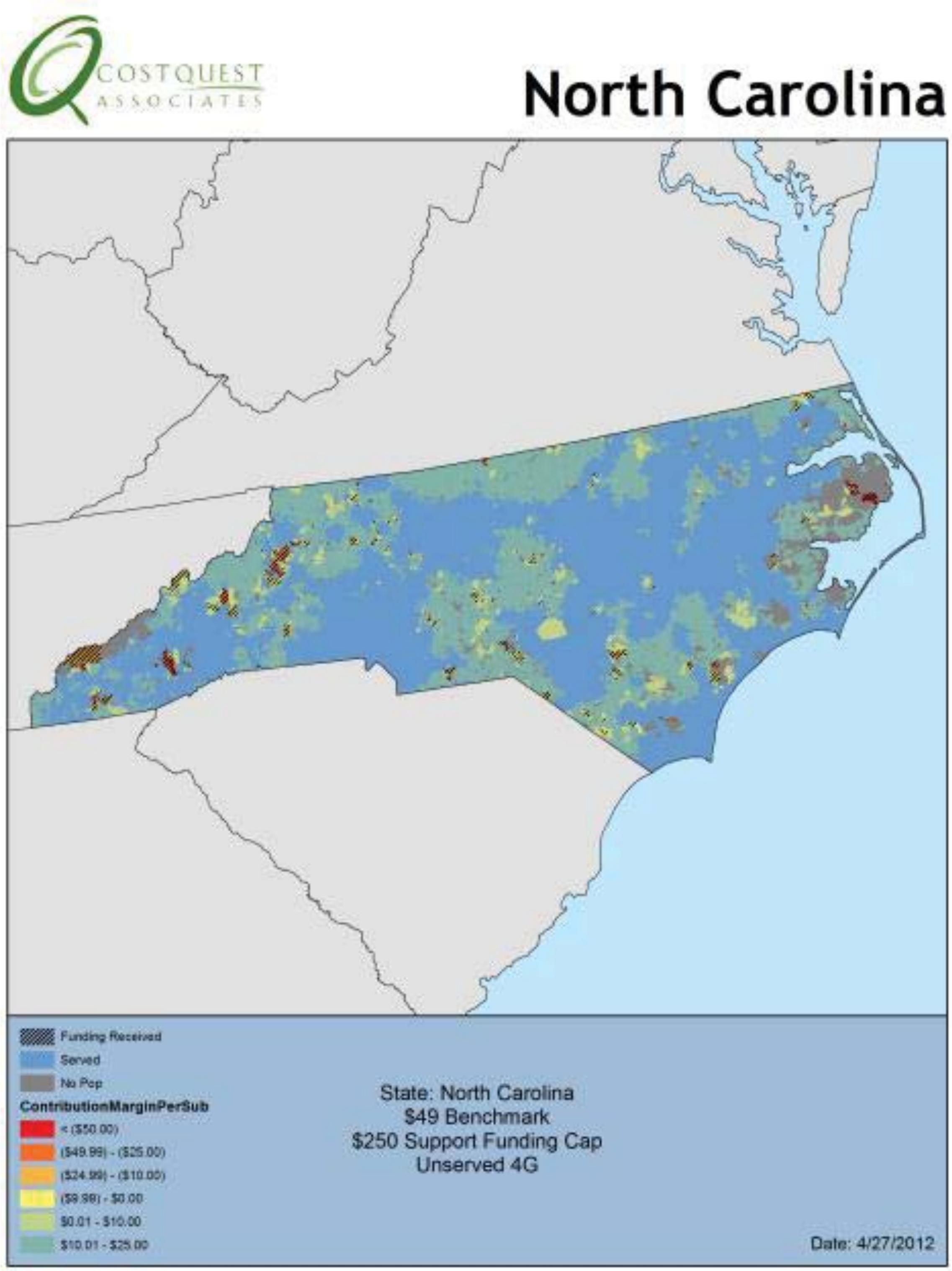
Mississippi Maps - 1900MHz Contribution Margin Map



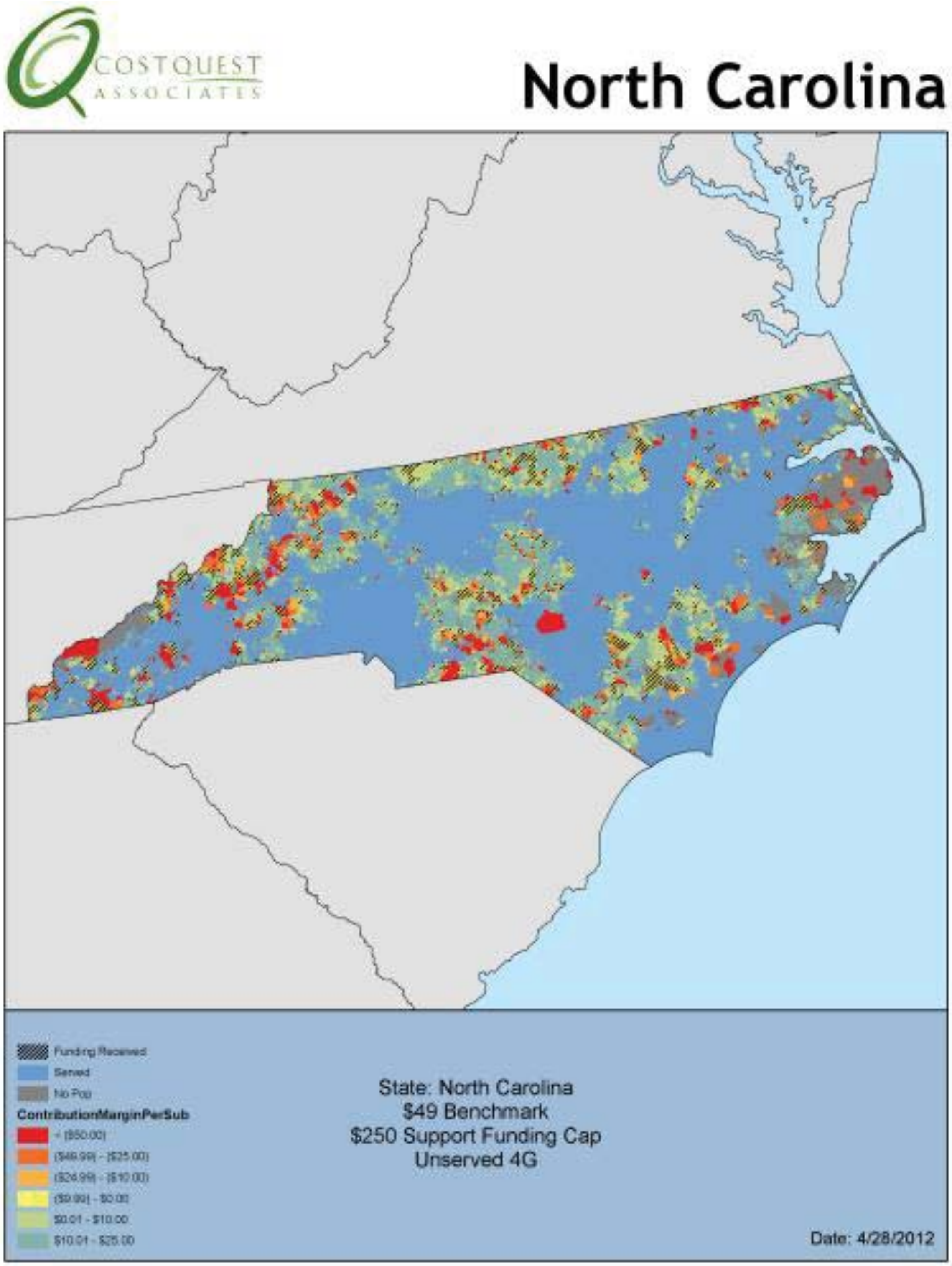
Model Results for North Carolina

North Carolina - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	970,490	970,490	0%
Funded Subscribers (Costs Exceed ARPU)	14,595	114,779	686%
Total Funding (Required Monthly Funding)	$207,654	$2,086,420	905%
Average Monthly Subsidy/(per funded sub)	$14	$17	21%
Average Monthly Cost/(per total subs)	$35	$41	16%
Total Annual Modeled Funding =	**$2,491,848**	**$25,037,044**	**905%**

North Carolina Maps - 700MHz Contribution Margin Map



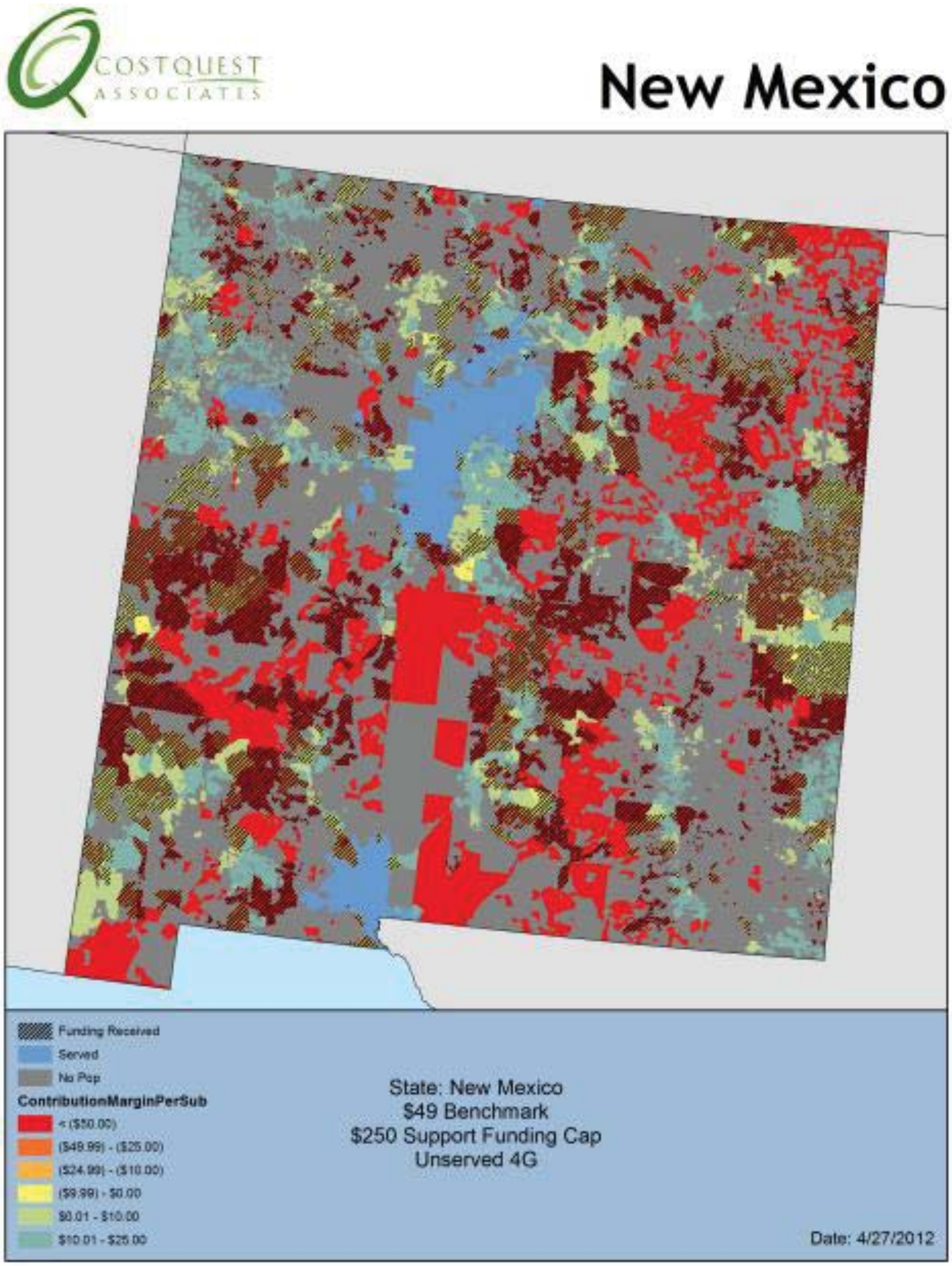
North Carolina Maps - 1900MHz Contribution Margin Map



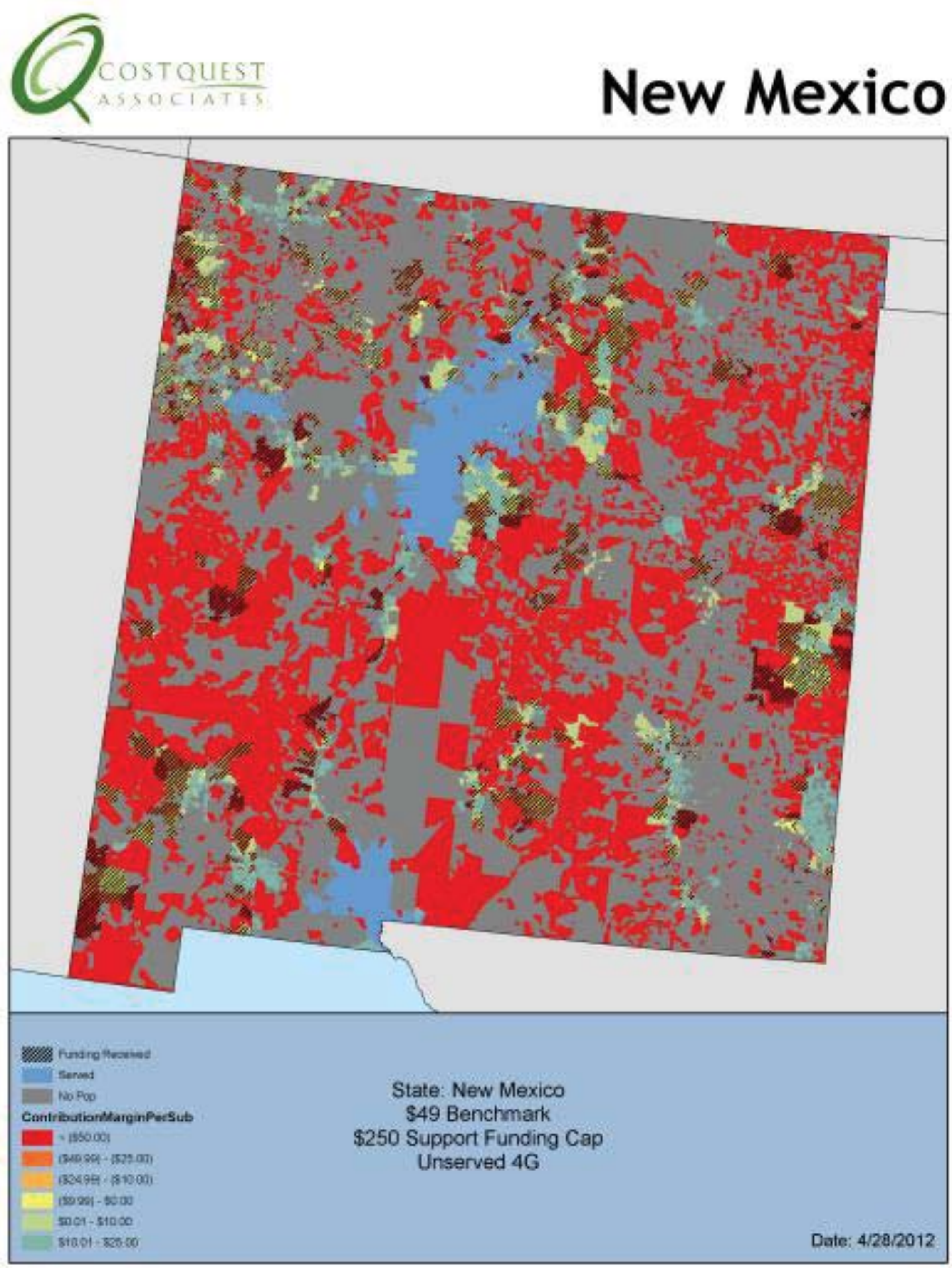
Model Results for New Mexico

New Mexico - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	619,619	620,788	0%
Funded Subscribers (Costs Exceed ARPU)	31,296	54,258	73%
Total Funding (Required Monthly Funding)	$1,676,999	$4,637,866	177%
Average Monthly Subsidy/(per funded sub)	$43	$48	11%
Average Monthly Cost/(per total subs)	$40	$53	33%
Total Annual Modeled Funding =	**$20,123,991**	**$55,654,394**	**177%**

New Mexico Maps - 700MHz Contribution Margin Map



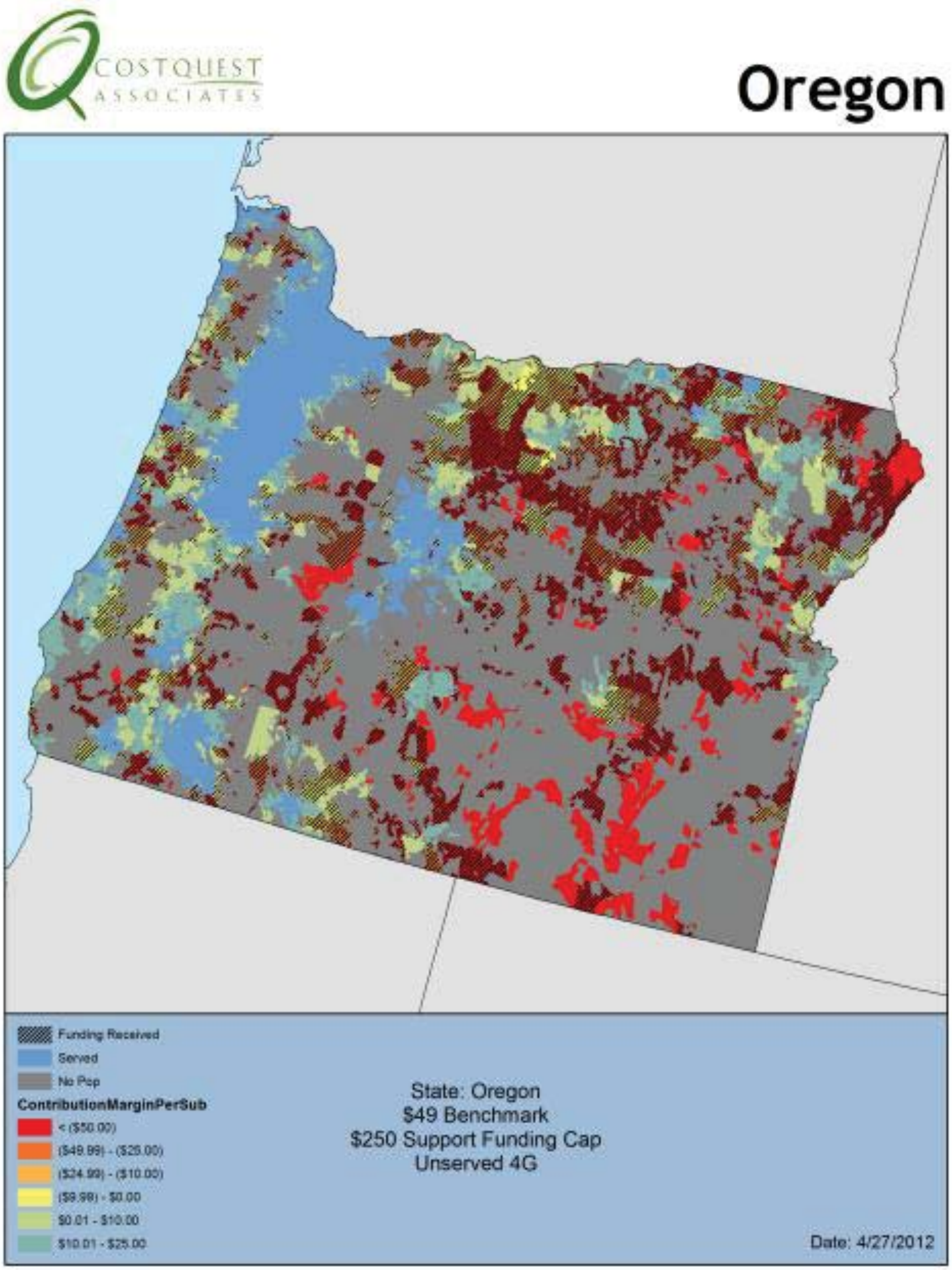
New Mexico Maps - 1900MHz Contribution Margin Map



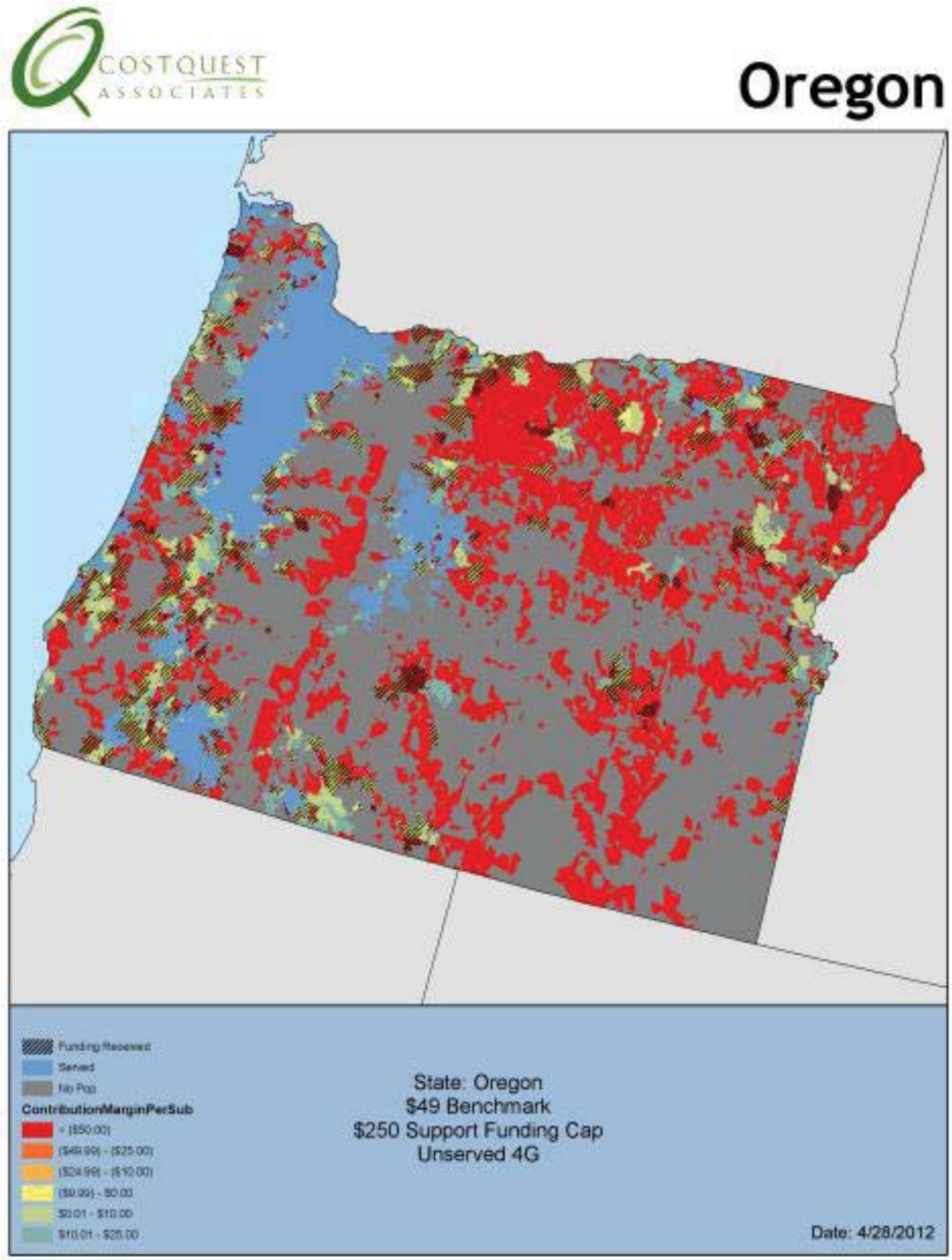
Model Results for Oregon

Oregon - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	462,751	464,091	0%
Funded Subscribers (Costs Exceed ARPU)	39,757	88,850	123%
Total Funding (Required Monthly Funding)	$1,472,980	$4,487,981	205%
Average Monthly Subsidy/(per funded sub)	$37	$41	13%
Average Monthly Cost/(per total subs)	$42	$58	37%
Total Annual Modeled Funding =	**$17,675,756**	**$53,855,778**	**205%**

Oregon Maps - 700MHz Contribution Margin Map



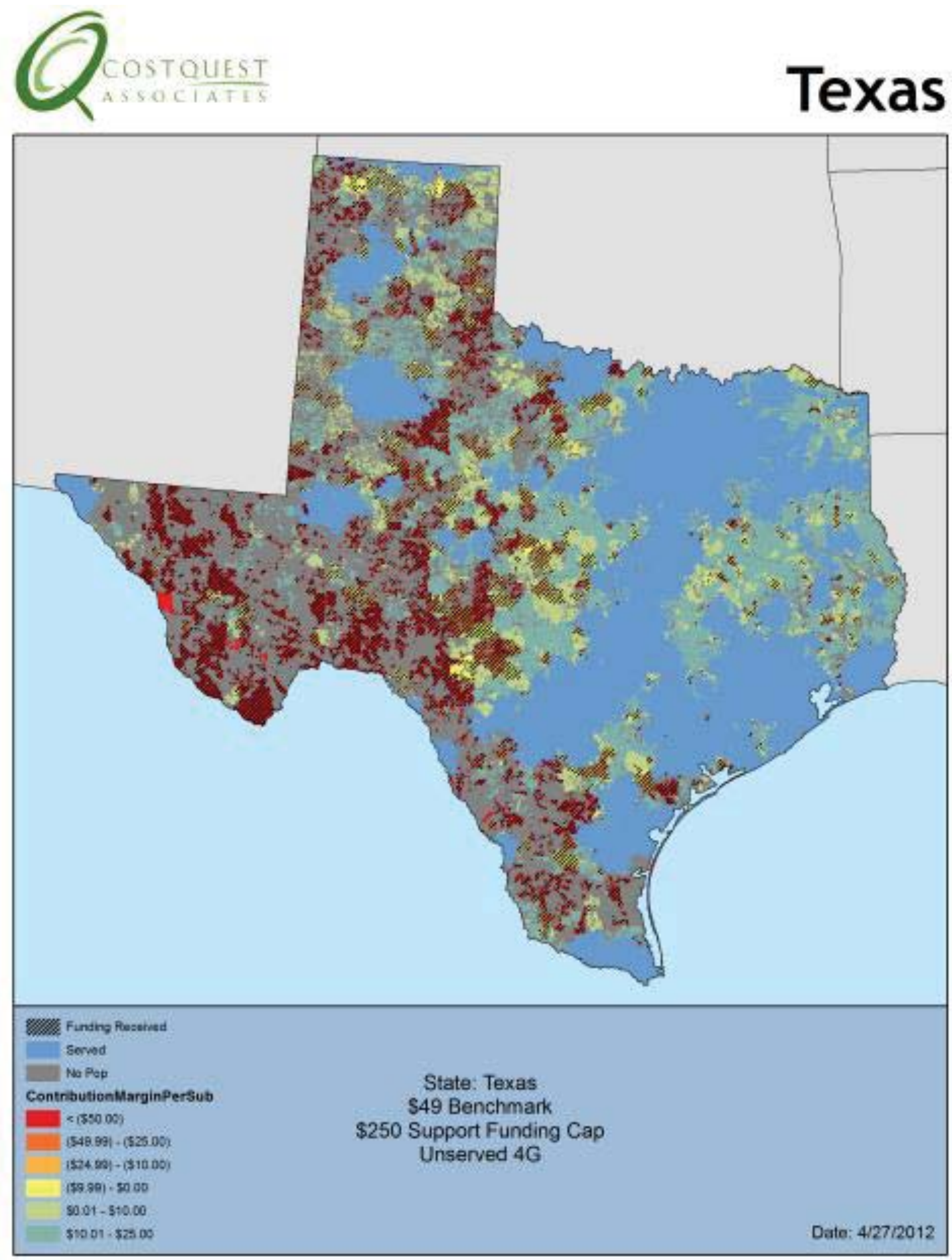
Oregon Maps - 1900MHz Contribution Margin Map



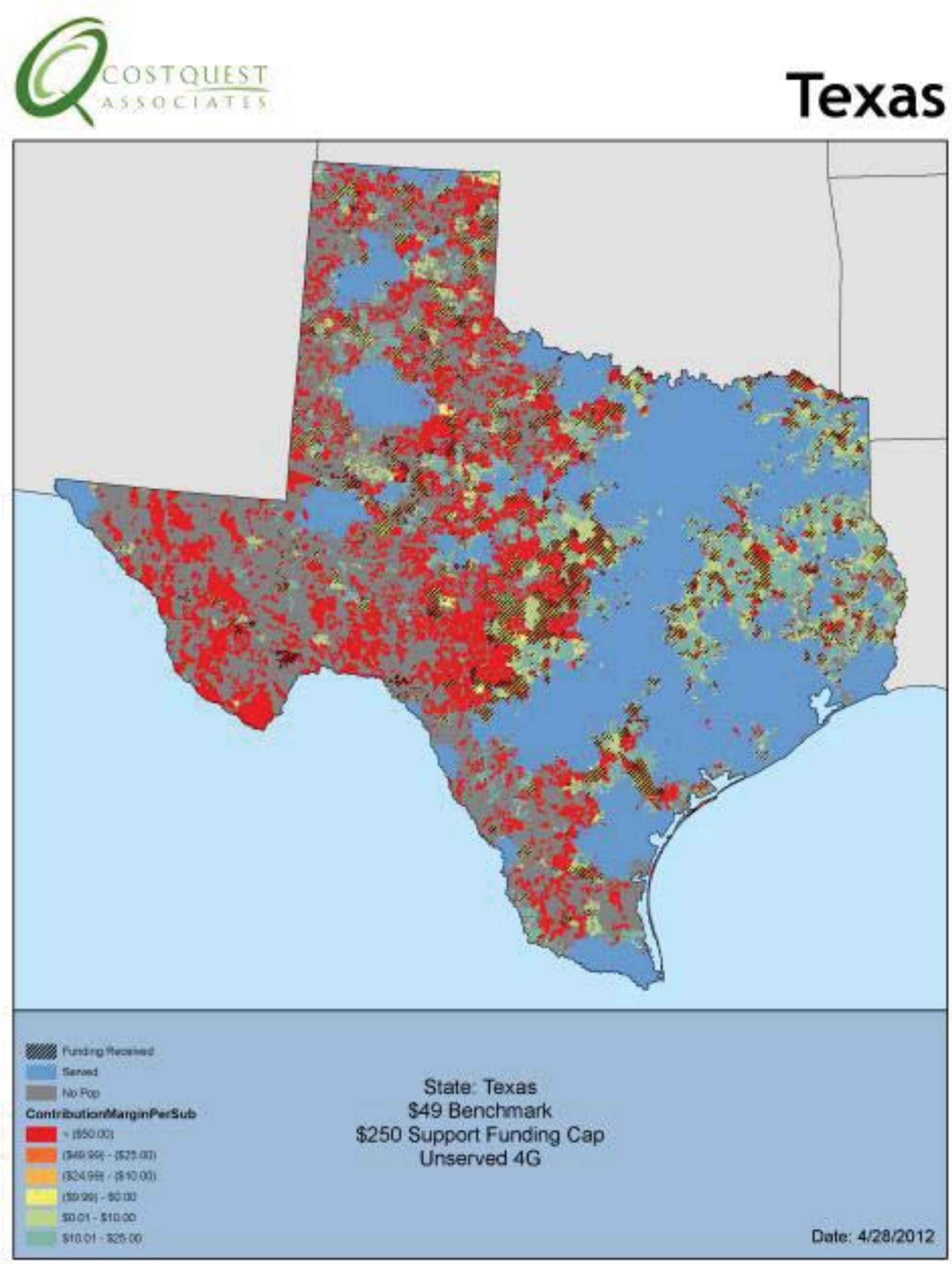
Model Results for Texas

Texas - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	1,324,617	1,325,095	0%
Funded Subscribers (Costs Exceed ARPU)	47,228	157,616	234%
Total Funding (Required Monthly Funding)	$1,546,918	$6,598,169	327%
Average Monthly Subsidy/(per funded sub)	$33	$34	5%
Average Monthly Cost/(per total subs)	$37	$45	24%
Total Annual Modeled Funding =	**$18,563,022**	**$79,178,026**	**327%**

Texas Maps - 700MHz Contribution Margin Map



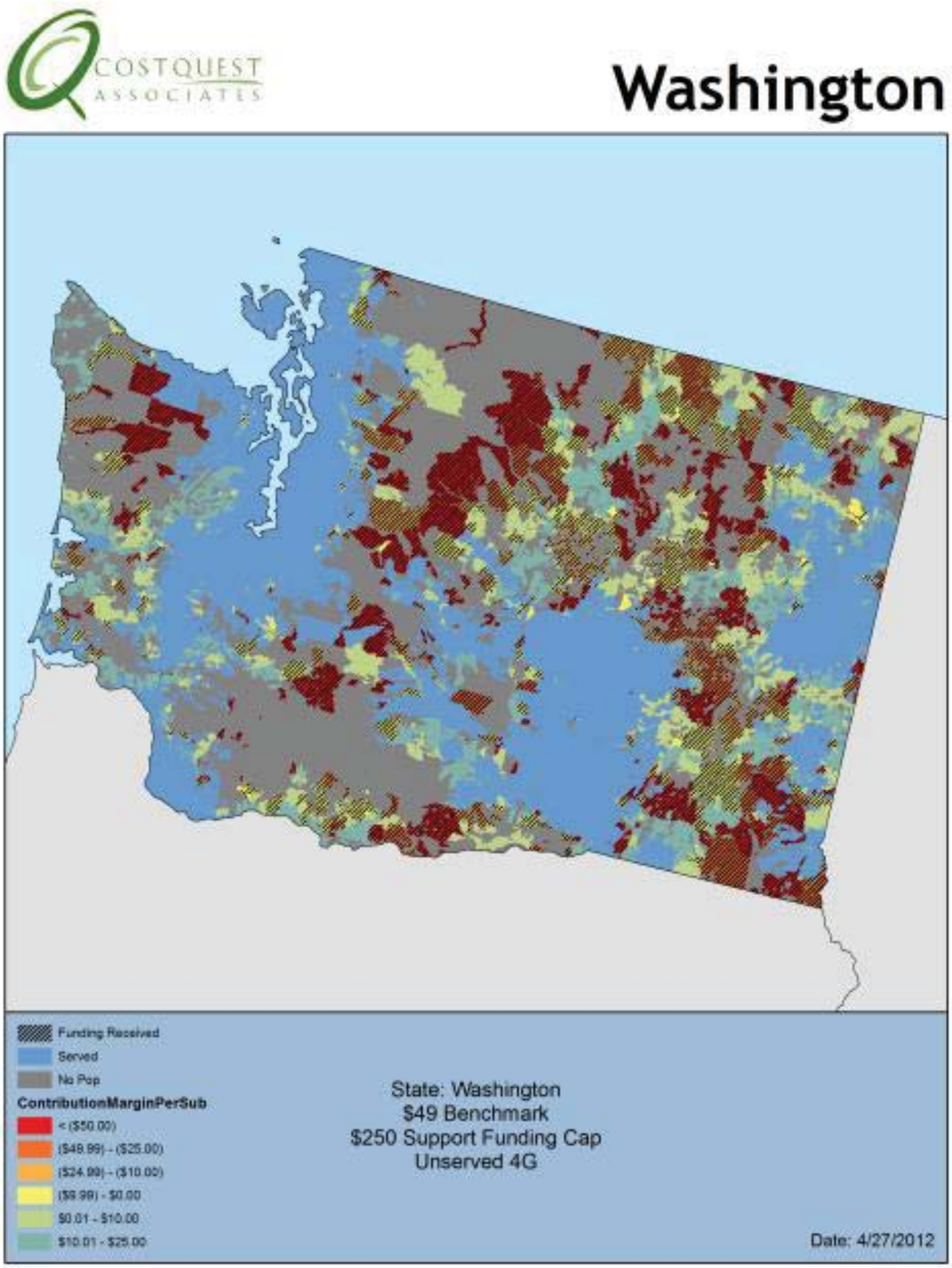
Texas Maps - 1900MHz Contribution Margin Map



Model Results for Washington

Washington - 1 Provider	700MHz	1900MHz	% Change
Total Subscribers	336,067	336,067	0%
Funded Subscribers (Costs Exceed ARPU)	33,783	85,544	153%
Total Funding (Required Monthly Funding)	$779,080	$3,243,702	316%
Average Monthly Subsidy/(per funded sub)	$23	$37	60%
Average Monthly Cost/(per total subs)	$40	$53	33%
Total Annual Modeled Funding =	**$9,348,960**	**$38,924,421**	**316%**

Washington Maps - 700MHz Contribution Margin Map



Washington Maps - 1900MHz Contribution Margin Map