ANGLE Technology Group

Prince George's County
Biotechnology Research and Development Center Study

Prepared for

The Maryland-National Capital Park and Planning Commission

Prince George's County Planning Department

Prepared by ANGLE Technology Group

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Table of Contents

Page

APPENDICES

Executive Summary

Prince George's County, MD is located in one of the world's leading bioscience research environments and within one of the largest and fastest growing state bioscience clusters in the United States. This research environment encompasses universities, research institutions and federal agencies with significant and largely untapped potential to create commercial products, drive new bioscience company growth and deliver substantial economic impact.

In a geographic sense, the heart of this research environment is effectively a research and innovation corridor that stretches from the District of Columbia north through western Prince George's County along US 1 to Howard County. This corridor is bounded by Montgomery County on the west and along the Baltimore-Washington Parkway on the east. The resources along this general corridor include the University of Maryland-College Park (UMCP), US Department of Agriculture-Beltsville Agricultural Research Center (USDA-BARC), Food and Drug Administration (FDA), Army Research Laboratory (ARL), and the MedStar Research Institute. While not physically located within the geographic innovation corridor, National Aeronautics and Space Administration's Goddard Spaceflight Center (NASA Goddard) and Bowie State University (BSU), are located in the county within a few miles from the corridor. In addition, Johns Hopkins University Advanced Physics Lab (APL) and the National Institutes of Health (NIH), located in neighboring Howard and Montgomery Counties, respectively, are key economic development drivers in the region.

However, despite the presence of this corridor, the number of bioscience companies and the impact of bioscience industry growth in the county has been limited compared with nearby jurisdictions which have fewer research and innovation assets.

The Maryland-National Capital Park and Planning Commission (M-NCPPC) Prince George's County Planning Department selected the ANGLE Technology to evaluate the economic feasibility of establishing a biotechnology research and development center (BRDC) in Prince George's County, MD to promote economic and community development. The project was defined in terms of Prince George's County's technology assets, unique market niches and opportunities for strengthening the county's biotechnology and bioscience cluster.

Numerous definitions are used for "bioscience" and "biotechnology." For the purposes of this study, the term "bioscience" uses the definition of Maryland's bioscience association, MdBio. By their definition, a bioscience organization is biology driven and its activity substantially involves research, development or manufacture of: 1) biologically active molecules; 2) devices that employ or affect biological processes; 3) biological information resources or 4) software designed specifically for biological applications. The terms bioscience and biotechnology will be used interchangeably in this report.

The study found that the vitality in the county's existing research and innovation corridor and the concentration of research activity in the National Capital area provide near-term opportunities for the county to capture new economic development associated with bioscience industry growth, if additional resources are directed to exploitation of these opportunities.

Bioscience company executives interviewed for this study also note that Prince George's County has an important business advantage—the costs of operation in Prince George's County are generally lower than the costs in neighboring counties.

Research and Innovation Infrastructure

The county's physical infrastructure to support basic research consists of office and meeting space, wet and dry lab space at the federal labs in the county, as well as UMCP. But there is limited space for biomedical research prototyping, commercialization and the initial expansion of young companies which requires access to relatively small amounts of wet laboratory facilities on a cost-effective and flexible basis.

The lack of available wet lab space for young, post-incubator companies to lease commercially makes it difficult for the Prince George's County Economic Development Corporation (PGCEDC) to retain and grow the companies that are founded in the county's technology incubator, the Technology Advancement Program (TAP) at UMCP. It is also difficult to attract additional, early stage life science companies to the county. The county's perceived lack of focus on the bioscience industry sectors in general, and on the programs that support growth, such as incubators, graduation space, tailored workforce training and specific financial incentives, has made it difficult for the county to successfully attract and grow these types of companies with the current level of PGCEDC resources.

Market Niches

Several market niches broadly related to the activities in the innovation corridor have been identified, based on the unique and growing research strengths at institutions in the county:

- Bioengineering and medical device design
- Nanotechnology and Nanomedicine
- Stem Cell Research

All three of these market niches are growing in size and significance, through increased federal and state funding, and market interest. There are also unique research strengths in the innovation corridor associated with agricultural biotechnology and food safety.

Biotechnology Research and Development Center (BRDC)

The study found that the establishment of a mixed-use BRDC with wet laboratory space for growing, young companies could in the near term address the four most critical unmet needs for the county's bioscience companies identified during the study:

- The need for **an identifiable focal point for county bioscience development**. For maximum impact, the BRDC should be in well-located facilities near technology generators, such as UMCP and the USDA-BARC, and near public transportation, such as Metro.
- The need for **wet laboratory space for commercial lease by young expanding companies** as part of a program managed or controlled by PGCEDC, to ensure the achievement of county economic development goals.

- The need for **appropriate technical workforce training** to provide the laboratory technicians needed for future county bioscience development. The availability of a trained workforce will support PGCEDC's own business attraction and retention efforts. Lack of an available workforce in the county is cited by growing biotechnology companies as one of the reasons that they do not choose to locate in the county. Workforce training activities could be located at the BRDC, as well as clinical trials, contract research and other related organizations.
- The need for **a more focused approach to the development of the bioscience cluster in the county** by PGCEDC. In the near term, the approach could build on increased leveraging and marketing of existing county assets. This would support the development and attraction of bioscience activities and signal the county's commitment to this industry sector.

The multi-tenant, flagship facility could offer:

- Accelerator/expansion office and wet lab space for young bioscience companies, such as TAP incubator graduates, to keep them in the county, as well as other small, but growing companies that could be attracted to the county.
- Availability of business accelerator support services for tenants, which could be offered by extending some aspects of the TAP program to the resident companies in the BRDC, under contract with UMCP.
- A location for workforce training programs that meet the needs of bioscience research and commercial activity in the county.
- Research space for related university and federal lab programs available on a flexible basis to help commercial and university users attract federal research funds.

Following consultation with the M-NCPPC Prince George's County Planning staff, it was decided that the study would focus on identifying sites and related development strategies which could be achievable in a timeframe of three to five years to help meet current bioscience industry needs. Longer-term and larger initiatives, such as the development of a 100 or 200-acre bioscience or biotechnology research park were not considered in this study.

Site Location

The location for the BRDC will be a critical element in its success. Six preliminary sites for the BRDC were identified and evaluated. The evaluation criteria were: location in the county's existing research and innovation corridor, proximity to public transportation throughout the day, such as Metro, county ownership of the site and site size (2 to 15 acres). These six preliminary sites were analyzed further and ranked. The site location criteria for this level of analysis included access to the research and innovation corridor, transportation accessibility (highway and Metro), availability and ownership of the land required, zoning, infrastructure required, development issues, traffic impact and image projected by the location.

The three top ranked sites identified through this process are located at:

- M-Square

- Konterra Business Campus
- Prince George's Plaza Metro

These three top ranked sites represent three workable, relatively near-term location options for the county. Two sites are in close proximity to UMCP. Two are located at Metro stations. The sites are relatively small, good building lots, ranging from approximately two acres to 12 acres. All three have good road access. Two of the sites are privately owned and the highest ranked site, M-Square adjacent to the College Park Metro Station, is owned by the county.

A seventh site, which could be of long-term interest for the county was identified through the study but not evaluated. This approximately 250-acre site in Beltsville, consisting of adjoining properties, is owned by the University of the District of Columbia and Howard University. It should be considered in the county's longer term plan to support bioscience development. The Howard University property is described in the university's Strategic Plan as "North Campus development". While not located very close to UMCP, it is about seven miles from the university, and it is near a growing group of the county's biotechnology companies.

Moreover, a Prince George's County development in this location off of US 1 and near the Intercounty Connector interchange on I-95, could anchor the growing bioscience research and innovation corridor that already stretches from Hyattsville, north past the USDA. A development in this location also could position Prince George's County to benefit from easier, more extensive connections west to Montgomery County companies and workforce via the Intercounty Connector.

Financial Impact

Financial impacts have been assessed for each of the three sites. While each site accommodates a BRDC with office and wet lab space, each site differs in terms of size and scope. The M-Square is assumed to consist of two, five-story buildings each comprising 105,000 square-feet. The Konterra Site is assumed to consist of three buildings and is estimated to comprise a total of 180,000 square feet. The Prince George's Plaza Site is assumed to consist of four, six-story buildings each comprising 120,000 square-feet. The three sites also differ in terms of configuration of space (i.e., percentage breakdown of office and wet lab space).

Findings for each of the three scenarios indicate that Prince George's County stands to gain significant economic benefits from the proposed BRDC. Results also suggest that the increased local government financial obligations associated with the operations of the proposed BRDC will be offset by annual tax revenues generated.

Projected State and County Economic and Fiscal Impacts:

The range of economic impacts is directly related to the physical size of each facility with the lowest impacts generated by the Konterra site, and the highest impacts generated by the Prince George's Plaza Metro site:

- Once fully operational, the proposed BRDC is expected to generate between 609 and 1,662 direct employees (employees working within at the BRDC). Estimated, average annual salaries for these jobs exceed $76,000.

- These direct jobs are estimated to create between 516 and 1,411 additional indirect and induced jobs for Maryland's economy.

- Between 699 and 1,907 total jobs are expected to be generated for Prince George's County's economy. Average annual salaries for these positions are estimated at $72,000.

- The proposed BRDC is estimated to generate between $8.4 and $23.0 million in annual state and county tax revenues.

- The proposed BRDC is estimated to generate between $0.3 and $0.7 million in annual property tax revenues and between $1.3 and $3.6 million in annual income tax revenues for Prince George's County.[1]

- The estimated addition of new residents and employees generated by the proposed BRDC will increase the demand for the provision of county services (i.e., public schools, water/sewer, road maintenance, etc.). Estimates of the annual costs for these additional services will range from $0.9 to $2.4 million.[2]

- The annual income and property tax revenues the BRDC is expected to generate for Prince George's County range from $1.6 to $4.4 million, offsetting the annual cost of services.

Implementation

Based on the feasibility study work, a three-phase approach could be used to attract and develop increased levels of bioscience research and development activity in Prince George's County, and to create the physical infrastructure to sustain this type of activity. The implementation plan outlines a manageable process that will require the engagement of many levels of county government and multiple partners. Based on the experiences of other communities in Maryland and across the country, the implementation of a BRDC in Prince George's County will require an on-going commitment of long-term political and programmatic support, as well as funding.

Immediate Steps: PGCEDC should work with real estate brokers of existing wet lab space in the county, such as Alexandria Real Estate, over the next six months to try and develop a system for accommodating bioscience company needs with existing, but underutilized wet lab space in the county. This is an important step because it reinforces the county's interest

[1] County property tax revenue estimates provided in this analysis include only the portion of property tax income associated with new home sales.

[2] As with County property tax revenue estimates, the cost of services estimates presented in this analysis include only the portion of cost of services attributable to residents moving into new Prince George's County homes.

in bioscience business attraction and growth and even modest success at this initial stage contributes to the next phase of implementation.

Near Term Steps: The county, with leadership from the PGCEDC, together with state, academic, industry and nonprofit partners should initiate planning for the BRDC within the next 12 months. A year-long implementation plan for this near term option has been outlined. A "design-bid-build" approach to the facility development is recommended. A number of experienced commercial developer partners with wet lab space projects in the region have been identified for this project. The county and the PGCEDC have additional options. PGCEDC also should position the BRDC for funding through BioMaryland 2020.

Longer Term Steps: The county, with leadership from the PGCEDC, and together with state, academic, industry and nonprofit partners should look beyond the next three to five years to further consider the establishment of a large-scale technology park in the county. The study identified an approximately 250-acre site in Beltsville, consisting of adjacent properties owned by the University of the District of Columbia and Howard University that could be a good location for this type of development. Howard University, with its Medical School, intensive doctoral/research focus and historic interest in Prince George's County as an expansion location, could be an important partner with the county in near-term projects, such as the BRDC, and longer term where the university and the county may share development interests at the site.

1. Introduction

The Maryland-National Capital Park and Planning Commission (M-NCPPC) Prince George's County Planning selected the ANGLE Technology Team to define and evaluate the economic feasibility of establishing a biotechnology research and development center, inclusive of biomedical research, in Prince George's County, MD to promote economic and community development. The ANGLE Team for this study included RESI Research and Consulting at Towson University and Capital Development Design, Inc. a minority-owned civil engineering and land use firm in Beltsville, MD.

The project was defined in terms of Prince George's County's technology assets, unique market niches and opportunities for strengthening the county's biotechnology and bioscience cluster.

The study work plan assessed the market need and defined the role of a biotechnology research and development center (BRDC) in the county. Based on criteria outlined by ANGLE, the M-NCPPC Prince George's County Planning staff identified six sites for further evaluation as potential locations for a biotechnology research and development center in the county. These six sites were evaluated using criteria reflecting industry best practice, as well as a stakeholder input. The list of sites was narrowed to three potential development sites. The financial, economic and physical impacts of these three sites were assessed. A general implementation strategy is proposed for the BRDC. This strategy includes recommendations on incentives, potential partners and tenants, as well as an implementation plan. This plan outlines specific steps that the county can take in the immediate, near and long term to advance this project. In addition to extensive market and regional economic research and analysis, nearly 40 interviews were conducted during the study with representatives from businesses, universities, local and state government, nonprofit organizations, federal agencies and county elected officials.

To assess opportunities related to the development of a biotechnology entity in Prince George's County, a sense of existing and emerging assets and trends that characterize the greater region surrounding Prince George's County is needed. This step ensures that this study identifies opportunities for Prince George's County that will build on rather than duplicate existing, regional strengths. The greater region, referred in this analysis as the study area is defined as follows: Prince George's County, Montgomery County, Frederick County, Howard County, Anne Arundel County, Baltimore County, Arlington County and Washington D.C.

A glossary of selected technology and zoning terms used in this report appears as Appendix IX to this report.

2. Definitions and Concepts

A number of terms and concepts will be used in the course of this study. These terms and concepts are defined in the following section.

2.1 Biotechnology and Bioscience Definitions

The term "biotechnology" is often not used in a standard or uniform way. During the past few years, the use of the term "biotechnology" has become quite broad and covers topics from drug discovery and drug production to medical devices and agricultural sciences.

The Biotechnology Industry Organization's (BIO) definition of biotechnology[3] is:

"Biotechnology---the use of cellular and bio-molecular processes to solve problems or make useful products. Biotechnology is a collection of technologies that capitalize on the attributes of cells, such as their manufacturing capabilities, and put biological molecules, such as DNA and proteins, to work for us."

Examples of specific biotechnologies (as cited by BIO) include the following:

- Bioprocessing Technology
- Monoclonal Antibodies
- Cell Culture
- Recombinant DNA Technology
- Cloning
- Protein Engineering
- Biosensors
- Nanobiotechnology
- Micro arrays

The applications for such technologies are broad and range from healthcare and agriculture applications to biodefense, bioengineering, industrial and environmental applications.

Maryland's bioscience association, MdBio, has elected to use a very inclusive term "bioscience" and DBED has also adopted this terminology. By their definition, a bioscience organization is biology driven and its activity substantially involves

[3] *Guide to Biotechnology 2008,* Bio Industry Association

research, development or manufacture of: 1) biologically active molecules; 2) devices that employ or affect biological processes; 3) biological information resources or 4) software designed specifically for biological applications.

In benchmarking reports on this industry sector[4], the Brookings Institution and Battelle use the terms "biotechnology" and "biosciences" when discussing the industry. Moreover, as Maryland DBED also uses these terms interchangeably, "biotechnology" and "bioscience" will be used interchangeably in this report, to be consistent with terminology used by Maryland DBED.

2.2 Biomedical Research Definitions

As with the terms "biotechnology" and "bioscience", the term "biomedical research" is used in a variety of ways by different groups and organizations. Many scientists and researchers interpret biomedical research very narrowly, as research conducted with patient populations and association with university medical schools and teaching hospitals.

For example, the National Institutes of Health's (NIH) National Library of Medicine (NLM) uses a simple but broad definition of biomedical research[5]:

"Research that is conducted to increase fundamental knowledge and understanding of the physical, chemical and functional mechanisms of human life processes and diseases."

However, for the purposes of this study, the broader, definition of biomedical research used by the Organization for Economic Co-operation and Development (OECD) will be used[6]:

"The study of specific diseases and conditions including detection, cause, prophylaxis, treatment and rehabilitation of persons.

The design of methods, drugs and devices used to diagnose, support and maintain the individual during and after treatment for specific diseases or conditions.

The scientific investigation required to understand the underlying life processes which affect disease and human well-being, including such areas as cellular and molecular bases of diseases, genetics and immunology."

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[4] *Signs of Life: The Growth of Biotechnology Centers in the US, 2002,* The Brookings Institution and *Growing the Nation's Bioscience Sector: State Bioscience Initiatives*, 2006, Battelle

[5] *Media Fact Sheet 2008*, National Institutes of Health (NIH)

[6] *Glossary of Terms*, Organization for Economic Cooperation and Development (OECD)

2.3 Drivers of Bioscience Development

To understand the position of Prince George's County in biosciences, it is important to consider four key drivers for bioscience development:

- Bioscience research base
- Bioscience industry base
- Innovation activity
- Bioscience workforce generation

Bioscience research base. Unlike many other industries, bioscience products and new venture development have strong links to basic and clinical research activities. This is partly due to the need to conduct research on patients in which medical schools and teaching hospitals offer significant access. But even with medical devices, bioscience research institutions play a key role in identifying needs, developing innovative solutions and helping refine new innovations. It's not just the size of the research activity, but how wisely it is developed and applied. Regions able to bridge from basic to clinical research and impact on the development of new advances in medical care and other bioscience tools and products in what is referred to "translational research" can leverage their research bases as a driver for economic opportunity.

Bioscience industry base. One way to judge the success of bioscience development is the extent to which it has translated into growing bioscience-related industries. One feature that marks the biosciences is the extensiveness of the industry opportunities it offers. These opportunities range across manufacturing, services and research activities. These opportunities include broad market areas from drugs and pharmaceuticals to medical devices, commercial research and testing, hospitals, laboratories and agricultural biotech. New areas, such as industrial biotech and environmental biotech, are also included. These bioscience industry sectors can be product oriented (organic agricultural chemicals, drugs and pharmaceuticals, and medical devices/instruments) or service oriented (hospitals and laboratories and research and testing.)

Innovation activity. To grow the Prince George's County biosciences cluster beyond its current position, it will be important to foster bioscience innovations, particularly to leverage the research base. Given the close connection of biosciences research discoveries to new product innovations and new venture development, success in translating basic research to clinical advances in new drug therapies, devices or medical practices can stimulate major bioscience industry development.

Bioscience workforce generation. The growth and development of bioscience in Prince George's County will depend on having a skilled workforce and generating graduates in bioscience-related fields. The popular vision of bioscience industries is that jobs are dominated by Ph.D.'s. In actual fact, the largest occupations are laboratory technicians, health care professionals, such as nurses and nurses' aides, and those working in production occupations. Looking to the future, the bioscience workforce will need to be an increasingly multi-disciplinary workforce integrating computer science, engineering, nanotechnology and other physical sciences to advance discoveries, develop products and deliver services.

2.4 Research and Development Centers

The first step in the establishment of a biotechnology research and development center is to understand the kinds of activities that might be conducted in such a center, who would be conducting them and how might the products of such a center be applied. Utilizing biotechnology techniques, biomedical researchers can study biological processes and diseases with the ultimate goal of developing effective treatments and cures.

The applications for such technologies are broad and range from healthcare and agriculture to biodefense, industrial products and processes, and environmental protection.

Research and development (R&D) centers have been organized for a wide variety of government agencies, universities, private companies and research institutes. In Prince George's County, National Aeronautics and Space Administration's Goddard Spaceflight Center (NASA Goddard) and United States Department of Agriculture's Henry A. Wallace Beltsville Agricultural Research Center (USDA-BARC) are good examples of government R&D Centers. Many of their research projects result in new technologies with commercial potential.

2.5 Innovation Zones and Technology Corridors

In the knowledge economy, business development and growth opportunities are increasingly concentrated around centers of innovation. Innovation Zones or Technology Corridors are defined geographic areas which attract R&D institutions and R&D companies by offering incentives for these organizations to locate in the zone or corridor.

Regional economic development organizations and states develop marketing programs by branding a geographic corridor containing R&D centers to attract businesses, as well as other R&D centers. In some cases, these programs go beyond marketing by establishing agreements among the institutions in the corridors to collaborate in developing proposals to government funding agencies and bundling their intellectual property to develop patent portfolios for licensing with increased commercial value.

Innovation and Technology Corridors have been established in many places, including Ohio, New Jersey, Pennsylvania, New Mexico, New Mexico, Tennessee, California, North Dakota, Australia and in the UK. Programs in Ohio, New Jersey and Pennsylvania illustrate this concept.

2.5.1 Ohio

Cuyahoga County, Ohio created an Innovation Zone to accelerate the rate of innovation in the economy of Cuyahoga County and Northeast Ohio. Cuyahoga County possesses a large number of innovation "anchors" around which an innovation zone has been established. These anchors include colleges, universities, research facilities and leading industrial organizations with research and development centers. The Innovation Zone is designed to leverage the economic development capacity of the region's institutional and industrial strengths and tie them together through a strategic, place-based economic development plan. This program provides matching funds for launching, developing and branding a Cuyahoga Innovation Zone.

2.5.2 New Jersey

The State of New Jersey has designated innovation zones in several cities where incentives include tax credits and priority access to entrepreneurial support programs. The New Jersey Economic Development Authority (NJEDA) created three Innovation Zones that encompass state universities, research institutions and related businesses. The zones include areas within the cities of Camden and Newark and the Greater New Brunswick area. Innovation Zones are a collaborative state effort involving the U.S. Economic Development Administration (EDA), the New Jersey Commission on Science and Technology and other state agencies.

These "technology neighborhoods" are designed to spur collaborative efforts and encourage the rapid transfer of discoveries from the laboratory to the marketplace. Enhanced financial incentives are available to eligible technology and life sciences businesses locating in these zones. Each zone also features a commercialization facility to provide specifically designed office and lab space for these early-stage growth companies.

2.5.3 Pennsylvania

The Keystone Innovation Zones (KIZs) in Pennsylvania are designated areas in communities that host institutions of higher education – colleges, universities and associate degree technical schools. The zones are designed to foster innovation and create entrepreneurial opportunities by gathering and aligning the combined resources of educational institutions, private businesses, business support organizations, commercial lending institutions, venture capital networks and foundations.

Pennsylvania is promoting a group of ten of their KIZs as the I-99 Innovation Corridor. These specialized locations are designed to link technology-based

companies with university faculty and research support. KIZs also offer incentives to launch faculty-based enterprises.

2.5.4 New Mexico

The New Mexico Technology Research Corridor (TRC) Collaborative was established in 2003 to encourage its members to work in concert to accelerate new technology business formulations that will benefit research institutions, entrepreneurs, industry, investors and the citizens of the state. The members agreed to work together to secure funding for multi-institution research, combine intellectual property into strategic patent portfolios, share best practices for technology commercialization, leverage synergies in 16 research programs and establish an administrative center. Today the corridor stretches along the Rio Grande River from Los Alamos to Las Cruces and includes three research universities, three federal laboratories, a university health sciences center and three private research institutes.

2.6 Research Parks

Research Parks also attract R&D centers. Many of these centers are associated with universities. A university research park is defined by the Association of University Research Parks as a property-based venture, which has:

- Master planned property and buildings designed primarily for private/public research and development facilities, high technology and science based companies, and support services
- A contractual, formal or operational relationship with one or more science/research institutions of higher education
- A role in promoting the university's research and development through industry partnerships, assisting in the growth of new ventures and promoting economic development
- A role in aiding the transfer of technology and business skills between university and industry teams
- A role in promoting technology-led economic development for the community or region

The park may be a not-for-profit or for-profit entity owned wholly or partially by a university or a university related entity. Alternatively, the park may be owned by a non-university entity but have a contractual or other formal relationship with a university, including joint or cooperative ventures between a privately developed research park and a university.

2.7 Research and Development Centers and an Innovation Corridor in Prince George's County

The principal R&D centers in the county are located at the University of Maryland-College Park (UMCP), U.S. Army Research Laboratory (ARL), NASA Goddard and USDA-BARC. The Johns Hopkins University Applied Physics Laboratory (APL) is located very close to the county line. All of these institutions are sources of new commercial opportunities in biotechnology and they have technology transfer programs. The Food and Drug Administration (FDA) is a key resource for these organizations and the FDA has offices in the county. Bowie State University, with its super computer, plus science and nursing programs is another resource. The general location of most these organizations along US 1 create a natural innovation corridor. This corridor could be formally defined and marketed to increase collaborative research opportunities with these existing R&D organizations. An established corridor would also attract new companies and service providers involved in the commercialization of the new technologies to the corridor.

2.8 Bioengineering

Bioengineering is an emerging area that draws from various scientific disciplines and includes the integration of physical, chemical or mathematical sciences and engineering principles for the study of biology, medicine, behavior or health.[7]

2.9 Nanotechnology

Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.

A nanometer is one-billionth of a meter. A sheet of paper is about 100,000 nanometers thick; a single gold atom is about a third of a nanometer in diameter. Dimensions between approximately 1 and 100 nanometers are known as the nanoscale. Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules.[8]

[7] National Institutes of Health website.

[8] National Nanotechnology Initiative (NNI) definition.

2.10 Nanomedicine

NIH defines the term, nanomedicine as an offshoot of nanotechnology, referring to highly specific medical interventions at the molecular scale for curing disease or repairing damaged tissues, such as bone, muscle, or nerve[9].

[9] National Institutes of Health Roadmap for Medical Research in Nanomedicine, 2006.

3. Needs Analysis/Market Assessment

Our market assessment considers industry developments and trends from a national, local and county perspective.

3.1 Industry Developments and Trends

3.1.1 National

Dramatic business development cycles are nothing new to biotech, but that does not mean that the sector does not warrant interest or investment. Biotechnology companies typically face longer development time frames than other types of technology companies. The development hurdles, which require extensive financial resources include:

- Longer clinical testing
- Tougher federal regulations
- Business plans with prospects for revenue that are far in the future
- Access to appropriate, affordable facilities and equipment

The U.S. biotechnology industry continues to mature and approach profitability. The year 2006 was characterized by a number of mergers and acquisitions (M&A). While this is an indicator of industry momentum, it also skews aggregate revenue data which helps to explain the net loss in revenues experienced by publicly traded U.S. biotechnology companies. Industry estimates indicate that were it not for this merger activity, the overall industry would have reached profitability for the first time in 2006.[10]

Even so, the year was characterized by a 14 percent annual increase in revenues of publicly traded biotech companies as well as a 38 percent hike in company R&D funding. As previously mentioned, M&A activity was rampant; 2006 is characterized by a record level of M&A deals, second only to 2000. In fact, the year 2006 saw increased competition and even bidding wars on the part of buyers. Much of this activity continues to be driven by big pharmaceutical companies' interest in attaining the "next generation of biotechnology platforms." [11]

The financing climate was also strong in 2006, and U.S. companies raised $20.3 billion, the second highest level achieved in the industry's history.

[10] Ernst & Young LLP. Beyond Borders: The Global Biotechnology Report 2006, "Strength and Stability: The Americas Perspective", 2006.

[11] Ernst & Young, page 36.

Commercialization appears to be the driving force of this positive industry momentum. The FDA approved 36 new products for the year, including 25 new drug applications and biologic license applications, up from 2005. At the same time, the U.S. is seeing an increasing pool of companies achieving strong growth from newly launched products. [12]

As shown in the following table, the Mid-Atlantic region was ranked among the top five regions in terms of performance among public, biotechnology firms in 2006. The expanse, which includes Maryland, Virginia, and the District of Columbia, was home to 23 public biotech companies with more than $2.0 billion in revenue and nearly $1.3 billion in R&D funding last year. These trends represent a significant acceleration from performance in 2005.

[12] Ernst & Young, page 29.

Top Five 2006 U.S. Biotechnology Areas, by Public Company Financial Highlights
(Millions in U.S. Dollars, Percent Change from 2005)

Region	Number of Public Companies	Market Capitalization	Revenue	R&D	Net loss (income)	Cash and Short Term Investments	Total Assets
San Francisco Bay Area	69	$145,553	$17,668	$7,485	$860	$11,348	$31,768
	0%	-10%	15%	65%	-307%	-10%	-7%
New England*	60	$62,936	$10,384	$3,919	$1,386	$7,063	$26,216
	3%	5%	16%	31%	36%	8%	4%
San Diego	38	$20,916	$3,252	$1,432	$1,069	$3,673	$8,589
	3%	6%	18%	32%	37%	17%	8%
New Jersey	28	$28,556	$1,747	$802	$344	$1,895	$3,196
	-3%	71%	23%	10%	-28%	-4%	-13%
Mid-Atlantic**	23	$17,111	$2,061	$1,270	$542	$2,861	$7,210
	15%	13%	8%	11%	-17%	22%	10%

* New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

** Mid-Atlantic: Maryland, Virginia, District of Columbia

Source: Ernst & Young Beyond Borders: The Global Biotechnology Report 2006, "Strength and Stability: The Americas Perspective", 2006.

3.1.2 Regional

The study area, which comprises Prince George's, Montgomery, Frederick, Howard, Baltimore, Anne Arundel and Arlington Counties as well as Washington D.C., adheres to the bioscience industry trends seen at the national level and continues to exhibit positive momentum. In the past, the biggest patent producers for greater Washington region have been the federal government and Lockheed Martin.[13]

Overall, Maryland's bioscience market continues to experience strong, positive momentum and performance. According to one estimate, the number of Maryland bioscience companies increased from 293 to 360 between 2002 and 2006; employment jumped from 17,000 to more than 23,000. At the same time, an increasing number of products are coming to market, and Maryland firms continue to

[13] Potomac Conference Technology Transfer Task Force, Metrics Group, "Technology Commercialization in Greater Washington", January 2004.

realize revenues. Therapeutics such as MedImmune's Synagis, Guildford Pharmaceutical's Gliadel, and United Therapeutics Remodulin are all prime examples. [14]

3.1.3 Prince George's County

The county is home to several significant federal and academic research centers including: the University of Maryland-College Park (UMCP), the Beltsville Agricultural Research Center (BARC), NASA Goddard Space Flight Center (NASA-Goddard), the MEDSTAR Research Institute, Bowie State University and the Army Research Laboratory (ARL), among others. Moreover, Prince George's County is proximate to several other key facilities including the Johns Hopkins Applied Physics Lab (APL) and the Food and Drug Administration (FDA) facility on the Montgomery County/Prince George's County line.

To date, however, this presence and proximity has not translated into a concentration of bioscience firms in the county to strengthen its bioscience cluster. In fact, an examination of MdBio's company database reveals that just 2.4 percent or eight of Maryland's 377 biotech companies are located in Prince George's County. This compares to 53.3 percent (or 201 firms) located in Montgomery County, another 14.9 percent or 56 firms in Baltimore City, 12.7 percent or 48 firms in Frederick County, and 7.4 percent or 28 firms in Howard County. The table below illustrates the geographic distribution of Maryland's biotech companies.

[14] Maryland Daily Record, Tech Link – Annual Bioscience Report

Geographic Distribution of MdBio Listed Companies

	Location (County)	Number of Bioscience Companies	% Distribution
1	Montgomery County	201	54.2%
2	Baltimore City	56	15.1%
3	Frederick County	48	12.9%
4	Howard County	28	7.5%
5	Baltimore County	11	3.0%
6	Prince George's County	8	2.2%
7	Anne Arundel County	7	1.9%
8	Carroll County	3	0.8%
9	Harford County	3	0.8%
10	Cecil County	2	0.5%
11	Charles County	1	0.3%
12	Dorchester County	1	0.3%
13	Kent County	1	0.3%
14	Worcester	1	0.3%
	Total*	371	100.0%

* Total includes three Maryland bioscience firms with location unknown, one Washington D.C. firm and one Newark, Delaware firm

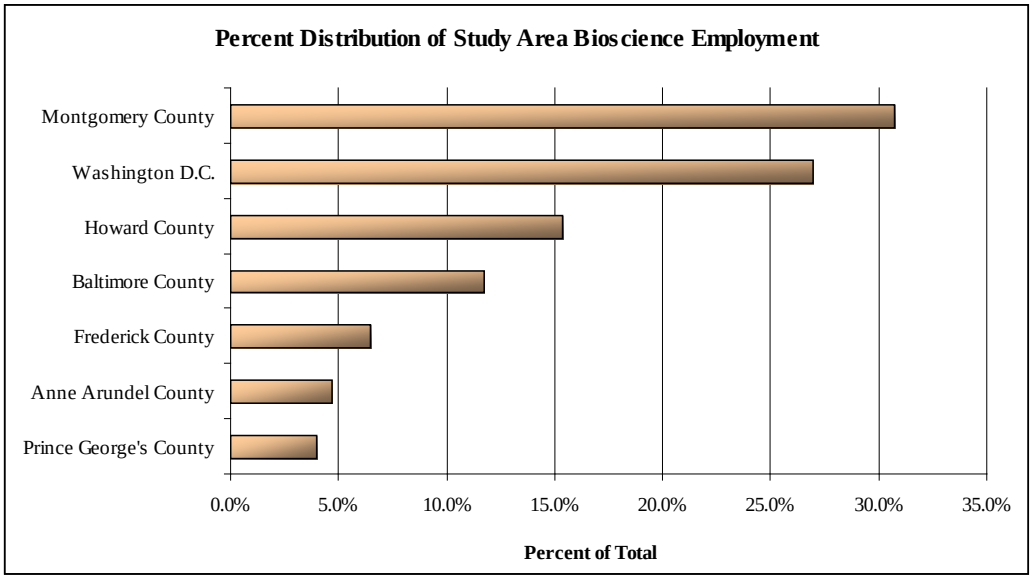
Source: MdBio, membership directory as of September 12, 2007.

This presence of biotech companies has not yet resulted in a large concentration of bioscience[15] employment within the county. According to Bureau of Labor Statistics data, bioscience industries employ more than 37,000 workers within the study area[16] as of 2006. Prince George's County's share of this total is just 4.0 percent or less

[15] As defined by the Maryland Governor's Workforce Investment Board.

[16] These employment figures exclude Arlington County.

than 1,600 employees. In fact, Prince George's County lags all other study area jurisdictions according to this measure. The largest share of bioscience workers is concentrated in Montgomery County (30.7 percent), followed by Washington D.C. with 27.0 percent.



Source: RESI, Bureau of Labor Statistics, Quarterly Census of Employment & Wages Data September 12, 2007.

Half of Prince George's county's bioscience firms (according to MdBio's member list) are located in Beltsville. Another two firms are located in Lanham. The remaining two are located in Adelphi and Hyattsville.

It should be noted that in 2007, Innovative Biosensors, Inc. relocated to the Red Cross' Jerome Holland Laboratory facility in Rockville, Maryland. The firm is a graduate of UMCP, Technology Advancement Program (TAP) Incubator and credits much of its progress to the support of the university's A. James Clark School of Engineering as well as to the Maryland Technology Enterprise Institute. According to the CEO of Innovative Biosensors, the move allows the firm to expand R&D programs and to expand the firm's manufacturing capabilities.[17] On a more positive note, BioServe announced that it will locate its U.S. corporate headquarters in Beltsville, Maryland. The headquarters will comprise a new 40,000 square-foot facility with office and wet and dry lab space.

[17] Innovative Biosensors, Inc. press release: "Innovative Biosensors, Inc. (IBI) Announces Relocation of Operations to The Red Cross' Jerome Holland Laboratory Facility in Rockville, MD."

MdBio Listed Firms in Prince George's County

	Company Name	Location	Year Established	Description
1	ProBiotix, Inc.	Adelphi	1995	Develops therapeutic drugs
2	Baxter Healthcare Corporation	Beltsville	1930s	Global healthcare company with expertise in medical devices, pharmaceuticals and biotechnology
3	Cytonix Corp.	Beltsville	1985	Manufactures numerous products for life sciences, aerospace and communications.
4	MetaMorphix, Inc.	Beltsville	1994	Conducts DNA research to improve the global food supply and human health. Discover and license targets to pharmaceutical companies developing therapies for better management of metabolic and muscular degenerative diseases.
5	Celadon Laboratories, Inc.	Hyattsville	1999	Developer of web-based software for the design of nucleic acid diagnostic assays.
6	GEO-CENTERS, INC.	Lanham	N/A	Provides products and services in chemical and biological research, detection, protection and defense.
7	Systems Assessment & Research,	Lanham	1994	Health care management and technology corporation; provides research services.
8	BioServe	Beltsville	N/A	Developing diagnostic tests.

Source: MdBio, membership directory as of September 12, 2007. Company websites.

3.2 Strengths, Weaknesses, Opportunities, Threats

Many forces will influence the development of a BRDC in Prince George's County. A good way to determine how these forces will impact the county is to perform a strengths, weaknesses, opportunities and threats examination, better known as a SWOT analysis. This initial analysis provides a starting point for planners and marketers and allows the team to focus in on key issues.

3.2.1 Strengths

Maryland's bioscience/biomedical industry is characterized by a strong R&D funding base.[18]

Five agencies supply nearly 95 percent of all federal research dollars nationwide, including the following:

- Department of Defense
- Department of Health and Human Services (including NIH)
- National Aeronautics and Space Administration
- Department of Energy
- National Science Foundation (NSF)

All five of the agencies above are located or headquartered in the greater Washington area. Maryland's proximity to and presence of these federal agencies is reflected in the R&D funding data. Nationally, the bioscience industry outspends the federal government in R&D by two to one; however, in the greater Washington region this is reversed. Maryland ranks first in the nation for per capita investments of federal research dollars and Virginia ranks third. In fact, federal R&D funding accounts for 82 percent of the region's R&D funding, while private industry R&D investment is rather low per capita and is less than one-third and one-fifth of that received by California and Massachusetts, respectively.[19]

Prince George's County institutions are in the vanguard of innovation in growth areas, such as bioengineering, food safety, and agricultural biotechnology for human health. The University System of Maryland (USM) has made significant investments in bioscience and bioengineering. Following the launch of a bio-engineering program at UMCP less than a year ago, the program has expanded rapidly and the university is already considering new space options. In September 2007, UMCP officially opened a new, $70 million state-of-the-art bioscience research building. The 134,000 gross square-foot building has 35 labs for as many as 33 faculty-led research groups, increasing the amount of high quality biosciences research space on the campus and making possible the new Maryland Pathogen Research Institute. The building also houses a 500-seat lecture hall and conference rooms for teaching and professional meetings. Several labs contain core instruments and equipment that researchers from many disciplines on campus can use for genomics and imaging. Two labs are Biosafety Level-3 (BSL-3) containment facilities, which will allow researchers to safely work with live pathogens, the microorganisms that cause disease. Flexible

[18] Potomac Conference Technology Transfer Task Force, Metrics Group, "Technology Commercialization in Greater Washington", January 2004.

[19] Id.

laboratory spaces can be configured for specific research needs and then reconfigured for new requirements. Post-doctoral, graduate and undergraduate students will be involved with faculty research in the new building. Located in the hub of some of the world's leading government and private bioscience research activity, UMCP will use the bioscience research building for research in three of the most exciting areas of contemporary science - pathogens, neuroscience, and genomics.

The USDA-BARC is the largest and most comprehensive freestanding agricultural research center in the world. Its research portfolio involves all 22 of the USDA's Agricultural Research Service (ARS) national programs. Since every scientific discipline related to agriculture is found at USDA-BARC (including economics), USDA-BARC, more than other ARS locations, is able to accumulate holistic, interdisciplinary approaches to problems of food and agriculture. This significant interdisciplinary strength coupled with USDA-BARC's ability to respond rapidly to new challenges and problems make this research center unique within the ARS.

3.2.2 Weaknesses

From a company attraction or economic development perspective, Prince George's County may not be considered an ideal location for biotechnology industry growth. The county's profile and business incentives are not competitive with surrounding jurisdictions which are successfully attracting and retaining broadly defined biotechnology and biomedical companies and expanding the research bases in their counties.

Biomedical research is typically associated with the presence of university medical schools and their teaching hospitals which provide hands-on experience to medical professional and access to patient populations for clinical trials. As the county lacks this infrastructure, it will be counter-productive for the county to try and position itself as a growing center of narrowly-defined biomedical research.

Federal research labs rather than universities or small companies perform most federally funded research in the greater Washington area. This higher concentration of research performed in federal labs, which tend to have limited patenting and licensing programs, is one indication for the lower number of patents and licenses for the region. In fact, federal labs in Maryland conduct over $10 billion of intramural research annually, twice as much as any other state.

The Washington/Baltimore region's venture capital climate is notably weaker than in other bioscience/life science clusters in the nation. Between 1995 and 2001, the region has received only about $85 million in funding. The top three bioscience/life science clusters combined received over $6 billion.[20]

[20] Cortright, Joseph and Heike Mayer, The Brookings Institution, Power point Presentation, "Signs of Life: The Growth of Biotech Centers in the US" June 2002.

Major players in venture capital for bioscience companies in Maryland include:

- Anthem Capital—early-stage venture-capital firm that invests in mid-Atlantic region.
- Boulder Venture Limited—venture capital partnership investing in life sciences in mid-Atlantic region.
- CIP Capital LP—provides expansion and later stage investment in life science.
- Toucan Capital—made four investments in bioscience companies in Maryland since 2001.
- New Markets Growth Fund—venture capital fund that makes equity investments and provides operational assistance to both early-stage ventures and small to mid-sized high growth companies located in Maryland, DC, or Northern Virginia.

The further development of the county's biotechnology sector will require political, as well as federal, state and county-level support and a shared vision. This industry goal should be specifically noted as a goal in the Prince George's County's economic development strategic plan. It does not appear in the current (2005) plan.

3.2.3 Opportunities

Prince George's County is home to an impressive number of research and innovation resources, such as the USDA, NASA-Goddard, FDA and UMCP. The leadership representatives of these organizations, in interviews for this study all expressed their willingness to work more directly with the county in order to establish stronger relationships to build increased research and commercialization activity.

There are many resources to support increased technology commercialization:

- Maryland Technology Development Corporation (TEDCO) has variety of innovative seed funding programs and funds for technology transfer and development.
- The University Patent Support Program, administered by TEDCO, is at the national forefront for states' efforts to support intellectual property generated by universities. Their goal is to increase the number of first patent applications on university technology.
- New Markets Growth Fund, a program at UMCP, makes venture capital available to small businesses in economically distressed regions of Maryland, Virginia, and DC.

There are numerous opportunities to encourage academic/industrial interaction:

- Maryland Industrial Partnerships (MIPS) provides matching funds for university-based research projects that help companies develop new products. The MIPS 2008 budget for projects is $2.05 million.

- University Technology Development Fund (UTDF) which is administered by TEDCO helps universities conduct pre-commercial feasibility research. FY2006 budget was $450,000

- University of Maryland's Technology Enterprise Institute connects biotechnology businesses with University of Maryland (UMD) researchers and provides ongoing technical assistance to these companies in their R&D efforts for product scale-up. As part of the program, UMD has a Bioprocess Scale-up Facility where companies, academic research and federal laboratories can take advantage of services like fermentation, separation, purification, and product analysis.

When completed, the planned Intercounty Connector will link northern Prince George's County directly with Montgomery County, making new commercial interactions between the business, research, and technology communities easier.

The successful evolution and growth of the bioscience industry in Montgomery County over the last 20 years may now be creating the perception that there is limited commercial space and opportunity for new companies in the county. There is also evidence that the cost of doing business in Montgomery County has risen. Other jurisdictions, such as Prince George's County, may offer lower business cost alternatives for these companies if comparable incentives and business support can be provided.

3.2.4 Threats

The competition for biotechnology development is continually increasing. Many regions with technology and research resources are now developing their biotechnology communities and actively competing for new biotechnology development to diversify their economic bases. Regions must work hard to retain their biotechnology companies and workforce, if they want to remain competitive.

The federal funding base for Maryland's biotechnology companies is narrow and it depends on only a few agencies. In addition, as the nation grapples with federal budget woes, a leveling off of federal R&D funding is anticipated over the coming years. In fact, in the summer of 2007, the U.S. Senate considered a FY2008 budget of $29.4 billion for NIH. This budget represents a $1 billion or 3.5 percent increase over FY2007's budget. While this increase sounds impressive, it is a far cry from the double digit budget increases the NIH has experienced in recent years. Moreover, this increase is less substantial than it appears, since the Senate subcommittee also increased the amount of transfer from NIH to the Global HIV/AIDS fund, thus reducing the actual increase for NIH programs to $799 million or 2.8 percent. NIH

notes in their budget request that they anticipate that the FY2008 budget will support just one-fifth of applications submitted, compared to one-third in FY 2003.

3.3 Inventory of Regional Assets and Resources

A number of local and regional technology assets can be leveraged to serve as catalysts for the proposed biotechnology/biomedical research and development center in Prince George's County. UMCP is the primary university research generator for the county, while there are three federal laboratories, USDA-BARC, NASA, and the FDA Center for Food Safety. ARL in Adelphi focuses on basic research on weapons and materials and MedStar Research Institute in Hyattsville, a non-profit biomedical research institute focused on contract research are other resources. Montgomery County's new East County Center for Science and Technology, which will be developed along US 29, bordering Prince George's and Montgomery County, could potentially be a resource for the proposed BRDC.

Business incubators can also be a resource to the proposed BRDC, as they are a source of prospects and program expertise and contribute to the overall technology and innovation profile of the county. There are two existing business incubators in the county. The Technology Advancement Program (TAP) at UMCP, which is the oldest technology incubator in the state, and the Technical Assistance Center (TAC) operated by the county in Largo. Approximately half of the TAP incubator clients are biotechnology companies, and upon graduation, these companies have chosen to establish operations outside of the Prince George's County.

TAC, which has no wet lab space, does not currently house any biotech companies. The center does, however, serve as headquarters for Bertron, a company which is developing advanced medical imaging technology under a Cooperative Research and Development Agreement (CRADA) with NASA Goddard.

Compared with the other jurisdictions in the study area, Prince George's County ranks second only to Montgomery County in the number of federal laboratories within its boundaries.

Research & Technology Assets By County									
	Prince George's County	**Montgomery County**	**Frederick County**	**Baltimore County**	**Howard County**	**Anne Arundel County**	**Washington DC**	**Arlington County**	**Total**
Federal Labs	3	8	1	0	0	1	1	4	**18**
Public/Private	1	3	0	2	2	0	2	0	**10**
Non-Profit	1	5	1	0	0	0	0	1	**8**
Incubators	2	5	2	2	1	1	0	0	**13**
Proposed	0	2	0	0	0	0	0	0	**2**
Total	**7**	**23**	**4**	**4**	**3**	**2**	**3**	**5**	**51**

Source: Economic Development Offices

A list of regional federal research laboratories in the study area, with program descriptions appears in Appendix I. A list of R&D funding for educational institutions in the study area appears in Appendix II. A list of academic and other research centers in the study area appears in Appendix III.

3.3.1 County Research and Technology Assets

The county's research and technology resources include universities and federal research centers.

3.3.1.1 University of Maryland, College Park

The University of Maryland at College Park (UMCP) is a major asset to Prince George's County's efforts to build upon its bioscience industry. Access to UMCP's faculty, graduate students and research facilities are all incredible resources for the county, as well as industry, research institutions and federal agencies.

UMCP operates the Technology Advancement Program (TAP) incubator. TAP is a venture incubator which focuses on maturing early-stage bioscience firms by providing them with needed business support, funding, infrastructure and other expertise.

UMCP is also home to a number of research centers, many of them focusing on biotechnology or bioscience. Among these are the:

- Center for Bio Systems Research (UM Biotechnology Institute)
- Center for Advanced Research in Biotechnology (UM Biotechnology Institute)
- Center for Agricultural Biotechnology
- Center of Marine Biotechnology
- Medical Biotechnology Center (UM Biotechnology Institute)
- Bioelectromagnetics Laboratory
- Center for Bioinformatics and Computational Biology

- Center for BioScience Research

Moreover, the potential for interaction with other academic departments at UMCP is substantial. The James A. Clark School of Engineering, which includes the newly created Fischell Department of Bioengineering as well as the Maryland NanoCenter are also important assets that could be leveraged in an effort to develop a BRDC within the county.

3.3.1.2 Beltsville Agricultural Research Center (BARC)

According to the USDA's Agricultural Research Service's website, BARC is "the largest and most diversified agricultural research complex in the world."[21] The research conducted at BARC aims to develop and disseminate solutions for problems which have been deemed priority agricultural harms to the nation. These solutions will be intended to increase food and agricultural product safety as well as improvement of the economics of the nation's agricultural economy. In addition, these resolutions must also enhance natural resources and preserve the environment. Areas of BARC research include the following:

- Air quality
- Animal health
- Crop production, protection and quarantine
- Food safety
- Global change
- Human nutrition
- Water resource management

3.3.1.3 Center for Food Safety and Applied Nutrition (CFSAN)

Located in College Park, the FDA's Center for Food Safety and Applied Nutrition (CFSAN) is tasked with securing the nation's food supply and ensuring that food and cosmetic products are safe and properly labeled. In fact, CFSAN is responsible for the regulation of more than 30,000 U.S. food manufacturers and processors as well as 3,500 cosmetic companies. The center regulates $270 billion in domestic and imported foods and cosmetic products. Among the center's main regulatory tasks are:

- Safety of substances added to foods

[21] Beltsville Agricultural Research Center Website, About Us page, Accessed in August 2007. htttp://www.ars.usda.gov/AboutUs/AboutUs.htm?modecode=12-00-00-00

- Safety of foods and ingredients developed through biotechnology
- Regulating the proper labelling of foods
- Seafood hazard analysis
- Regulation and research of health risks associated with food borne chemical and biological contaminants[22]

3.3.1.4 NASA Goddard Space Flight Center (NASA Goddard)

Located in Greenbelt, Maryland, the NASA Goddard was established in 1959. According to their website, NASA Goddard houses the nation's largest organization of combined scientists and engineers dedicated to learning and sharing their knowledge of the Earth, solar system, and Universe.[23] Components of the Center's mission include:

- Develop and operate a range of flight missions.
- Conduct research in the space and Earth science disciplines.
- Provide and operate spaceflight tracking and data acquisition networks.
- Develop and maintain information systems to display, analyze, archive and distribute Earth science data.
- Develop National Oceanic and Atmospheric Administration (NOAA) satellite systems for forecasting and research purposes.[24]

3.3.1.5 The Army Research Laboratory (ARL)

Located in Adelphi, Maryland, ARL serves as the Army's laboratory for basic and applied research. ARL comprises the Army Research Office, as well as six additional components, which are:

- Weapons & Materials
- Sensors & Electron Devices
- Human Research & Engineering
- Computational & Information Sciences
- Vehicle Technology
- Survivability & Lethality Analysis

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[22] Center for Food Safety and Applied Nutrition, Overview, February 2001.

[23] NASA Goddard Flight Space Center Website, about page, accessed in August 2007.

[24] Id.

The mission of ARL is to conduct scientific and technological research and analysis in an effort to increase the success of war fighters in battle.[25]

3.3.1.6 MedStar Research Institute

The Institute, located in Hyattsville, conducts medical research and support and serves as the research center for MedStar Health. Composed of seven hospitals which provide care to more than 130,000 inpatients and 905,000 outpatients, MedStar is the largest health care provider in the Baltimore/Washington area. The Institute's research ranges from basic to clinical trials. Among the Institute's research specialties are:

- Cardiovascular Disease
- Oncology
- Diabetes/Obesity
- Neuroscience
- Maternal & Child Health
- Orthopaedics/Sport Medicine
- Critical Care/Bioterrorism[26]

3.3.1.7 Bowie State University (BSU)

Bowie State University, like the UMCP, is part of the University System of Maryland (USM). Bowie State is the oldest historically Black College/University in Maryland and one of the ten oldest in the country. It is also a diverse university whose 5,400 students, along with faculty and staff, are made up of a diverse array of ethnic backgrounds. In addition to its 25 undergraduate majors, Bowie State offers 30 masters, doctoral and advanced certification programs, including a nursing program. Its advanced research facilities include one of the world's 100 most powerful supercomputers and a satellite operations control center managed in conjunction with NASA Goddard.

3.3.1.8 The Johns Hopkins Applied Physics Laboratory (APL)

Although APL is located in Howard County, its proximity to Prince George's County makes it an asset to regional bioscience/biomedical development. The nonprofit

[25] U.S. Army Research Laboratory Website, About Us Page, Accessed in August 2007.

[26] MedStar Research Institute, Areas of Expertise page, Accessed in August 2007.

center is located on a nearly 400 acre campus and receives roughly $680 million in annual funding. APL performs a wide range of research work for the Department of Defense and other federal agencies. Among the areas that APL research targets are:

- Air and Missile Defense
- Biomedicine
- Homeland Protection
- Infocentric Operations
- Science & Technology
- Strategic Systems
- Warfare Analysis[27]

3.3.2 Incubators in the Region

The study area has significant infrastructure to support early-stage and start-up biotechnology companies. However, the availability of affordable graduation space in the region for incubator graduates is limited.

All six of the business incubation programs in the study area offer business support services, as well as office facilities and wet laboratory space. There is steady demand for business incubation program participation. All but one of these incubator programs is fully occupied.

The table below captures a quick snap shot of each of these incubators for easy comparison.

[27] John Hopkins Applied Physics Laboratory Website, Our Work page, Accessed in August 2007.

Existing Incubators in the Study Area								
Facility	**Client Mix**	**Industry Focus**	**Mission**	**Service Offering**	**Square Footage**	**Type of Space**	**Type of Center**	**Location**
Business and Technology Growth Center	Biotech/Tech	Place new high tech companies may flourish. Partnered with TAP	Provide place in which new high-tech start up companies can obtain the support they need in order to flourish	Business guidance, funding help, and facilities	1,000,000	Office space, access to facilities at UMD	Public/private, UTC, TAP and PG EDC involved	Prince George's
Frederick Innovative Tech Center, Inc. (Hood, Monocacy)	Biotech/Tech	Offer local entrepreneurs environment, facilities and services to prosper	To offer facilities, services, and an environment in which start up businesses can prosper	Business plans, facilities	Combined 21,000	Fully furnished offices, equipped labs, conference room, etc. (2,500 sq. ft. wet lab)	Public, OED creation.	Frederick
Maryland Technology Development Center	Biotech/Tech	Take advantage of local research and academic resources	Specialize in helping small companies realize big dreams	Business support services, office and lab space	60,000	60 offices and 24 wet labs (18,000 sq. ft. web lab)	Public, Montgomery County business network	Montgomery
TAP	Biotech/Tech	Accelerate growth of emerging tech enterprises	Expedite maturation of young firms	Business support, access to funding sources	Over 20,000	Fully furnished offices, 15,000 sq ft wet labs	Public Education Institution	Prince George's
techcenter @ UMBC	Biotech/Tech	Areas of UMBC strength	Enhance UMBC's economic impact	Tech transfer, facilities, mentoring	108,000	Wet lab & office space. (40,000 sq. ft. wet lab)	Public Education Institution	Baltimore County
Germantown Life Sciences Incubator	Biotech/IT	Support incubator for biotech and IT companies	Research, education, facilities	Provide facilities and other mechanisms for start up biotech and IT companies	30,000 sq. ft.	Lab and office space	Local government sponsored	Montgomery

Source: Survey of incubator managers in August 2007

Two additional incubators have been proposed in the study area. Both of these projects plan to include wet lab incubator space for their client companies.

Study Area – Proposed/Planned Incubators

Facility	Primary Function	Research Focus	Service Offering	Mission	Square Footage or Acreage	Type of Space	Type of Center	Location
East County Center for Science and Technology (White Oak)	Bioscience and Technology	Bioscience park with labs, office space, incubator and educational facilities	Research, education, facilities	Provide facilities and close proximity to FDA headquarters for growing and developed biotech companies.	800,000 sq. ft. when completed, on 115 acres.	Research, education, facilities	Private	Montgomery
East Baltimore	Biotech	Support incubator for biotech companies	Research, education, facilities	Provide facilities and close proximity to Hopkins	60,000 sq. ft. when completed,	Research, education, facilities	Non-profit	Baltimore City

Source: Survey of incubator managers in August 2007

3.4 Gap Analysis of Regional/County Biotech Infrastructure

Based on research and interviews to date, several gaps in the county's biotech infrastructure are apparent:

- While the county is home for UMCP with all of its technology activity and Bowie State with its nursing program and science programs, the county lacks two key components of biomedical research: a university medical school and a teaching hospital, which can provide access to a patient population.
- Companies in the county interested in bioscience business incubation have a choice of programs in the region with wet lab space.
- One important infrastructure gap identified through the interview process was the lack of graduation, or accelerator space, available on a flexible lease basis for maturing biotech companies when they leave the TAP incubator at UMD. Without the availability of this kind of office and wet lab space, two or three TAP graduates typically leave the TAP program each year and relocate their young companies in adjacent counties, where there are more space options and a vibrant life science community.

- A prototyping facility would support the bioengineering and medical device development work underway at UMCP.

- An animal research facility would support the bioscience research at UMCP.

3.5 Potential Partners

Creating effective partnerships across the range of activities required to establish a BRDC will be key to the success of the proposed project. Partners will be needed for the financing and construction of physical facility, as well as the program development and ongoing operations of the project. Specific partnering options will be explored in detail in the course of the study, but initial research and interviews indicates that the county could have a range of potential partners for the various aspects of establishing a BRDC. There is general interest in capital funding from the EDA at the federal level and from DBED and TEDCO at the state level. County support would likely be programmatic. There also may be interest from commercial real estate developers and other commercial entities, depending on the real estate market at the time of development. In a general sense, potential partners have already been identified within UMCP, FDA, and USDA-BARC, as well as the other research and development resources in the county and the region. In addition, there are unique partnering opportunities, given the county's location adjacent to the District of Columbia, which is home to several medical schools and teaching hospitals, such as Howard University, Georgetown University, and George Washington University, as well as national associations, such as BIO.

3.6 Potential Market Niches

In a general sense, viable market niches are those where unique and specialist technology resources and professional expertise can address growing markets. With the range of bioscience activity in the Greater Washington and Baltimore region, the county should focus in areas where county-based assets of its university, federal laboratories and other organizations are well-positioned to advance research and development activity in growing markets. Based on study research, there are opportunities in several growth markets, including food safety and agricultural biotechnology. Moreover, the three market niche areas receiving the greatest increase in NIH funding are all in areas that can be broadly defined as bioscience:

- Bioengineering and medical device design
- Nanotechnology and Nanomedicine
- Stem Cell Research

These market niches are discussed in Section 6.

3.7 Interview Sessions

A list of stakeholders was developed for the project with input from the project committee. More than 30 interviews were conducted in the course of the study with stakeholders, including county and state government representatives, universities, training institutes, research programs, life science companies, and real estate developers. Names of interviewees may be found in Appendix VIII.

3.7.1 Interview highlights

The establishment of a BRDC should be viewed in its regional economic development context. A project of this type can raise the profile of Prince George's County as a growing center for biotechnology and as a key component in the overall bioscience industry in the State of Maryland.

The BRDC should be a multi-user facility focused on providing business accelerator space, including offices and wet labs. The BRDC should be designed to help accelerate commercialization and wealth creation associated with the bioscience industry in the county. The BRDC also can help retain biotechnology incubator company graduates in the county and attract new research activities and commercial activity that diversifies the county business base.

The technology focus of the proposed BRDC should be broad enough to include some of the unique strengths in the county's technology community: bio-engineering, food safety, and agricultural biotech for human health.

Workforce training programs should also be included as part of the BRDC.

The county should continue to strengthen its relationships with biotechnology resources, such as UMCP, BSU, USDA-BARC, CFSAN, ARL and the MedStar Research Institute.

4. Assessment of Potential for BRDC

4.1 Description of Proposed Center

Established by Prince George's County and its partners, the proposed Center could be a phased, multi-user development. It may offer the critical combination of business support services and cost-effective, modern office and wet lab space that would help accelerate research collaborations and the commercialization activities of maturing biotechnology or biomedical companies. The BRDC could offer:

- Business support services delivered by the county and its partner organizations
- Shared amenities – lower operating costs
- Turn-key office and wet lab space
- Located in proximity to the county's research and innovation base

The proposed Center could be designed to assist companies interested in teaming with the county's research and innovation institutions, such as the University of Maryland-College Park, USDA, FDA and others. The Center could be physically designed to accommodate anchor tenants. The Center also could include a workforce development component for the county. The Biotechnical Institute of Maryland is an example of the kind of organization that could provide technical training for technicians, as well as custom developed education programs for commercial clients.

4.2 Proposed BRDC Mission and Service Offerings

The mission of the BRDC would be to stimulate collaboration and to accelerate the commercialization of biotechnology in Prince George's County. The Center could be the flagship and catalyst for the growth of the biotechnology industry and its workforce in the county.

The service offerings would be designed to focus on the commercialization of technology, including technology developed by organizations in Prince George's County. The service offerings also would assist young companies who might be graduates of one of the business incubators in the region. Typical service offerings could include:

- **Receptionist Services**-Meet and greet guests, answer phone, sort mail, coordinate conference room use and audio-visual equipment.
- **On-Site Program Management**-Program director offering advice and counselling, and referral to networking, technology transfer and business development resources.
- **Funding Access**-On-site access to venture capital firms and Angel Investor Clubs, and assistance in applying for funding from public funding programs

such as Maryland Technology Equity Fund, TEDCO Technology Transfer Fund, Federal SBIR, DARPA, ATP programs and more.

- **On-Site Intellectual Property and Legal Resources-**The Maryland Intellectual Property Legal Resource Center (MIPLRC) could be located within the MTDC and offer legal advice and assistance on patent, copyright and trade secrets issues.
- **Professional Development and Consulting Services-**Breakfast or lunch meetings with guest speakers and networking events scheduled on a weekly basis provide the BRDC tenants with the latest information on business, legal and technical issues.

As the program develops, additional revenue generating programs and services, such as specialist workshops and meetings could be actively sought.

5. Assessment of Market Demand

Maryland's strengths include one of the world's leading bioscience research environments and one of the largest and fastest-growing bioscience clusters in the country. But despite Maryland's strong foundation and steady gains in recent years, the state is in a race to the future for bioscience global leadership. Nearly every state in the United States, most developed and many developing countries are targeting the biosciences as a growth driver for their economies. It is increasingly recognized that the biosciences represent a large and fast-growing sector which includes a wide-range of job-producing manufacturing, service and research activities.[28]

What remains striking about Maryland is its still enormous untapped potential in the biosciences. The state is working to maintain and strengthen its historic leadership in bioscience research, but it is also working harder and smarter to accelerate the rate at which its research strengths translate into viable start-ups, commercial products and more mature bioscience companies that are able to grow and sustain themselves profitably over the long term.

Maryland Governor O'Malley has recognized this and in June 2008 he announced a ten-year, $1.3 billion strategic initiative to move Maryland bioscience forward. BioMaryland 2020 is the strategic plan for the Governor's initiative. This plan was developed by the Maryland Life Sciences Advisory Board and released in May 2009. The plan includes a recommendation to invest in the infrastructure and the physical environment which support bioscience growth.

Bioscience firms, in particular tend to cluster close to each other and to other research institutions, including universities and academic medical centers. In addition to wanting to be near collaborators, bioscience companies also require access to wet lab space, shared equipment and business services. States and counties seeking to grow their bioscience cluster realize that they must invest in physical infrastructure to provide an attractive location for their bioscience companies and research institutes.

The existing Innovation Corridor in Prince George's County along US 1, with its university, research institute and federal agencies, is a source of specific bioscience demand for services and facilities which position the county to play a central role in the further development of the bioscience industry in the county and in the state.

[28] BioMaryland 2020, May 2009.

5.1 Maryland Incubator Capacity and Graduation Space

A study of Maryland technology incubator capacity concluded that Maryland has the potential to support new technology incubators, given the state's strong technology-based economy, abundant research, concentration of technology employment and political support for technology-based economic development.[29] Maryland incubator managers interviewed for the study noted that assisting incubator companies once they graduate is an important issue. These managers indicated that post-incubator assistance could potentially help companies remain successful and further contribute to Maryland's economy as the business grows over time.

Moreover, survey interview findings indicate that locating suitable space is the most pressing issue for graduate companies, especially those in biosciences. This concern could be addressed through the creation of business accelerators that include wet lab space or the establishment of grant funds or loan programs to assist companies in customizing their own space after graduation from the incubator. The creation of a BRDC with graduation space in Prince George's County is in line with these findings.

5.2 Facility Demand by Type, Use and Industry Category

Based on the market assessment discussed in Section 3 of this report, the proposed BRDC facility is envisioned to include office space for partners and other relevant organizations and wet lab space for maturing bioscience companies. It also has been recommended that retail space be included on the street level of the facility.

5.2.1 Sources of BRDC Tenants

The BRDC would be expected to attract tenants from four sources:

Partners (university, research institutes, service providers)

A number of relevant bioscience research and partner organizations have been identified through the study.

Maturing bioscience companies in the region

These could be existing companies. They also could be university or corporate spin-outs.

Graduates of Maryland incubator programs

With several incubation programs in the vicinity, it is likely that incubator graduates from TAP or UMBC would be attracted to the BRDC.

[29] Maryland Incubator Impact Analysis and Evaluation of Incubator Capacity, RTI International, 2007.

Business attraction

Just as incubators can be "landing pads" for new businesses locating in the area, the BRDC could attract small, but growing bioscience companies interested in a location near UMCP, USDA-BARC or other resources in the Innovation Corridor. These could be US companies or international companies.

5.3 Local Market Niches

Maryland provides a dynamic and innovative environment for bioscience company development. Maryland is home to more than 400 bioscience companies and 50 research-intensive federal institutes and centers. Maryland ranks first among the 50 state in per capita academic bioscience R&D (2006) and second in per capital NIH awards (FY2007).

Despite its continued growth, the bioscience industry in Maryland is still emerging. While Maryland is ranked highly and specialized in bioscience research and development, it is not yet specialized in the overall bioscience industry like its key benchmarked peers of California, Massachusetts, North Carolina and Pennsylvania.

Maryland companies and institutions are involved in a number of markets. Some of Maryland's current market leaders and innovators in bioscience include:

Biotherapeutics and Diagnostics — MedImmune, Human Genome Sciences, Advancis, GenVec, Martek, Otsuka, BD Diagnostics, Digene, Invitrogen and Qiagen

Agricultural Biotechnology— USDA-BARC, Center for Biosystems Research and Center for Advanced Research in Biotechnology II

Pharmaceutical & Biomanufacturing/Bioprocessing — Cambrex, Chesapeake Biological Laboratories, Shire U.S. Manufacturing, and Pharmaceutics International

Bioinformatics — Gene Logic, Celera Genomics and the National Institutes of Health

Based on the unique research and technology resources in the county and the pattern of NIH research funding, it is reasonable to expect demand for services and facilities that drive the development of emerging market companies built around technology niches such as bioengineering, nanotechnology and stem cell research. There are opportunities companies working in these market areas to develop and expand in Prince George's County.

5.3.1 Research Space Demand

The amount of research space at research universities has expanded at a rapid pace (11 percent) in the first three years of the 21st century. More than half of this expansion was slated for biological or medical science research, which would indicate that the space is likely to be wet lab space. Between 2004 and 2005, universities reported planned construction for another 19 million square feet of research space, of which the vast majority (72 percent) is designated for engineering, biological and medical sciences research. Nearly one million

square feet of research space was slated for UMCP.[30] However this space would be for university use.

See Appendix IV for a table of research space in academic institutions.

5.3.2 Wet Lab Space Demand

In 2006 and 2007 the picture for biotechnology companies in the Washington-Baltimore region changed. Private investment slowed and total public finance in the region for biotech in those years amounted to $158 million, only 3 percent of the nationwide $5.2 billion invested.[31]

At the same time, vacancy rates in local bioscience real estate climbed to between 13 and 20 percent, depending on whether laboratory space was included. However, this trend should not deter the development of the proposed BRDC. Research activity at the UMCP continues to grow steadily. Based on interviews with incubator managers in the region, long term demand remains strong for small amounts of wet lab space (up to 5,000 square feet) available on a flexible basis for maturing bioscience companies.

5.3.3 Wet Lab Space Supply Challenge

The supply of wet-lab space, space that is equipped with water, direct ventilation and specialized piped utilities allows for testing of chemicals, drugs and other biological matter has been an issue in Maryland for many years. Historically, real estate developers have lacked confidence in the re-lease potential and marketability of wet-lab and bioscience space, especially since much of this space must be customized. The end result is that obtaining financing for these properties is more difficult. In the current economic environment, this is especially true. The fact that Maryland bioscience firms are typically attracted to metropolitan areas that house science centers (NIH, Johns Hopkins University, UMCP, etc.) has further impacted the development of additional wet-lab supply. These metro areas are usually characterized by high land prices and a lack of large parcels of developable land which, historically, has resulted in an undersupply of wet-lab space in Maryland.

5.3.4 Availability of Wet Lab Space

Maryland is currently home to approximately 900,000 to one million square feet of wet lab space. Wet lab space for incubator companies is available in several locations, including:

- Association for Entrepreneurial Science in Rockville is a privately operated 48,000 square-foot incubator that includes wet-lab space. It is operated by the nonprofit Biomedical Research Institute.

[30] Battelle Technology Partnership Practice. "Executive Summary" Growing the Nation's Bioscience Sector: State Bioscience Initiatives 2006. p.vii-xxii. June 2006.

[31] Ernst & Young.

- Maryland Technology Advancement Program (TAP) at the University of Maryland College Park, the state's oldest incubator has more than 15,000 square feet of wet-lab space.

- University of Maryland Biotechnology Center (UMBI) has 1,700 to 2,000 square feet of lab space and focuses on biomedical and pharmaceutical areas.

- Technology Development Center (MTDC) in Montgomery County is operated by the Maryland High Technology Council and includes approximately 30,000 square feet of wet lab space divided into 24 labs.

- techcenter@UMBC, University of Maryland Baltimore County includes 45,000 square feet of wet-lab space. The techcenter@UMBC is considering to build a 60,000 square-foot wet lab and office building over the next five years to meet anticipated demand.

- Frederick Innovative Technology Center, Inc. (FITCI) includes 4,500 square feet of wet-lab space with six companies currently operating in the incubator requiring wet-lab space. FITCI is expected to build a new 50,000 square-foot facility within the next five years that will include additional wet-lab space.

This information does not take into account wet lab space under the control of private companies or part of federal programs. It also does not take into account the lab space that is sought by maturing bioscience companies, who need between 1,000 and 7,000 square feet of space on a flexible lease basis.

Montgomery County has an estimated 200,000-250,000 square feet of commercially available wet lab space, so young, growing biotechnology companies can generally locate appropriately sized wet lab space in that county. The Prince George's County Economic Development Corporation (PGCEDC) estimates that Prince George's County has less than 50,000 square feet of wet lab space available commercially. Therefore the options for capturing maturing biotechnology companies and the economic impact they can generate, also is limited, without the infrastructure which could be provided through the proposed BRDC.

6. Cluster Development Potential

Knowledge is the source of competitive advantage in technology-based industries, such as biotechnology research and development. U.S. Economic Development Administration (EDA) studies indicate that trying to "seed" an industry cluster from scratch is generally unsuccessful. Cluster-based economic development strategies have their greatest chance of success where assets, market opportunities or innovative activities are present in some concentration, as is the case in Prince George's County.

Bioscience cluster development in Prince George's County will be driven by a number of specific factors:

Cutting edge research that produces innovations around which entrepreneurs can build technology companies. Achieving critical mass in this area requires a solid, broadly defined bioscience base.

Effective technology commercialization, the process of getting university and other publicly sponsored research from the laboratory to the marketplace. Licensing revenue and the number of companies formed around university-developed and federal lab-developed technology provides an insight into the strength of commercialization activities in a community.

Entrepreneurial culture includes people willing to take the risk of starting and working for a company at a stage when there is risk and little money and people with entrepreneurial business acumen to work with young companies.

Access to capital, including seed and venture funds that support biotechnology and biomedical companies at all stages of development. These companies can have difficulty attracting funds because of their lengthy development timeframe and unusual funding curve.

Industry infrastructure that includes access to professional services, such as commercialization expertise, plus patent and clinical trial firms.

Quality of life becomes an issue when companies recruit executives and communities recruit companies. The natural environment, and cultural attractions, as well as the variety of housing options and the quality of K-12 education can be factors that affect location decisions for companies and employees.

Skilled workforce is a critical issue for cluster and company development, expansion and attraction. Ongoing technical training through universities and other institutions is required.

The establishment of a BRDC could provide a focal point for the county's activities to strengthen its bioscience business base.

6.1 Growth Trends for Targeted Market Niches

The growth trends and research funding patterns associated with a market niche can be future indicators of market growth in that niche. The technology areas receiving the greatest amounts of NIH funding will be poised for future growth.

6.1.1 Federal Market Funding

In May of 2009, NIH analyzed funding levels for specific diseases, conditions and research areas for the period extending from fiscal years 2005 through 2010.

In addition to actual funding figures for the fiscal years 2005 through 2008, estimates are provided for fiscal years 2009 and 2010 (based on the FY 2010 budget). The funding amounts listed in the table below include actual grants, contracts and other research. The following table details this funding history for select NIH research areas (excluding funding for specific diseases/conditions). The data show that the three research areas experiencing the most rapid average annual increases in funding (between fiscal years 2005 and 2010) include: bioengineering (with an increase of 14.5 percent), nanotechnology (12.0 percent) and stem cell research (8.2 percent). As discussed previously, bioengineering and nanotechnology are two acknowledged areas of strength for Prince George's County research institutions. Maryland State funding for stem research, coupled with the increased levels of NIH funding, could spur new related market opportunities in this area. Funding for food safety, which had been one of the fast growing NIH funding areas in previous years continues to receive funding and remains an important market niche for county institutions, given the presence of USDA-BARC.

NIH Funding for Select, Research/Disease Areas, FY 2005 – 2010

(Current Dollars in millions, rounded[32])

	FY 2005 Actual	FY 2006 Actual	FY 2007 Actual	FY 2008 Actual	FY 2009 Estimated	FY 2010 Estimated	Average Annual % Change
Biotechnology	$10,889	$9,974	$9,814	$5,179	$5,390	$5,468	-10.8%
Genetics	$4,840	$4,878	$4,878	$6,872	$7,066	$7,173	6.8%
Infectious Diseases	$3,188	$3,132	$3,059	$3,575	$3,678	$3,725	2.6%
Emerging Infectious Diseases	$1,872	$1,857	$1,816	$2,098	$2,156	$2,179	2.6%
Biodefense	$1,696	$1,766	$1,735	$1,736	$1,777	$1,793	0.9%
Vaccine Related	$1,450	$1,449	$1,358	$1,632	$1,675	$1,698	2.7%
Immunization	$1,438	$1,438	$1,342	$1,734	$1,779	$1,804	3.9%
Bioengineering	$1,318	$1,546	$1,469	$2,853	$2,932	$2,973	14.5%
Human Genome	$1,084	$1,065	$1,099	$1,259	$1,297	$1,317	3.3%
Stem Cell Research	$609	$643	$657	$938	$963	$977	8.2%
Genetic Testing	$422	$417	$395	$383	$395	$402	-0.8%
Gene Therapy	$355	$356	$325	$249	$255	$259	-5.1%
Food Safety	$329	$316	$278	$244	$250	$253	-4.3%
Nanotechnology	$165	$192	$215	$304	$311	$326	12.0%
Gene Therapy Clinical Trials	$31	$32	$31	$16	$16	$17	-9.5%

Source: NIH Budget FY2010

[32]National Institutes of Health, "Estimates of Funding for Various Research, Condition, and Disease Categories". Note – funding is not additive; in other words funding in one area may also be included in another area's funding.

Nanotechnology & Nanomedicine

NIH funding in nanotechnology has increased at an average annual rate of 12.0 percent between fiscal years 2005 and 2010, from $165 to $326 million.[33] Other statistics, as noted by the Daily Record's Tech Link publication, find that overall federal funding in the U.S. for nanotechnology R&D has increased from $464 million in 2001 to $1.08 billion in 2005. Prince George's County is home to the Maryland NanoCenter at UMCP. The center involves collaboration among various university departments. This is an area that has been recognized as one that requires industry and university collaboration. Federal agencies, such as the National Cancer Institute, have also expressed interested in nanotechnology research.[34]

NIH defines nanomedicine as: "highly specific medical intervention at the molecular scale for curing disease or repairing damaged tissues."

Bioengineering

Bioengineering is an emerging area that draws from various scientific disciplines and includes the integration of "…physical, chemical or mathematical sciences and engineering principles for the study of biology, medicine, behavior or health".[35] NIH funding in this area has increased at an average annual rate of 14.5 percent between fiscal years 2005 and 2010, from $1.3 billion to $2.9 billion. Moreover, NIH's newest institute, the National Institute of Biomedical Imaging and Bioengineering (NIBIB) (formed in 2000), focuses on this field specifically. Located in Bethesda, NIBIB's mission is to: "improve health by supporting and conducting interdisciplinary research and training in biomedical imaging and bioengineering…"[36] Also of significance: Maryland's approved FY2007 budget included $2.3 million in operating funds for a new biological sciences research building at UMCP.[37] In addition, UMCP is home to a newly created bioengineering graduate program.

Stem Cell Research

NIH funding in Stem Cell Research has increased at an average annual rate of 8.2 percent between fiscal years 2005 and 2010, from $609 to $977 million. Furthermore the state of Maryland has invested in Stem Cell Research since 2007 after an independent Stem Cell Research commission was created. During FY 2007 and

[33] NIH Funding Estimates.

[34] Maryland Daily Record, Tech Link – Annual Bioscience Report, "The Maryland Biotech Boom", February 2007.

[35] National Institutes of Health website.

[36] National Institutes of Health Website, About NIH page, Accessed in August 2007.

[37] Department of Budget and Management, "Fiscal Digest of the State of Maryland for Fiscal Year 2007", July 2006.

2008, nearly $38 million was used to fund 82 projects. For FY 2009, the state plans to award another $18 million and has already received 147 applications.[38] This is more than a 20 percent rate of growth over the previous year's submitted applications.

Food Safety

While not in top three growth areas for NIH funding in the table above, NIH funding in food safety remains very important. In fact, NIH funding for food safety increased at an average annual rate of 7.0 percent between fiscal years 2003 and 2008, from $208 to $312 million. This is also a key research area for USDA-BARC, which is part of the ARS. With a FY 2007 budget of $1.1 billion, the ARS conducts over 1,200 research projects and employs 2,100 scientists at over 100 research locations. The types of ARS research occurring in Maryland ranges from gene evaluation and mapping, biology, immunology and disease resistance to instrumentation and sensing, and physiology. Many bioscience firms in Maryland have cooperative research and development agreements (CRADA's) with USDA- BARC.

6.1.2 Academic Market Funding Potential

Roughly 60 percent of the $1.1 billion in R&D funding expenditures by the study area educational institutions (FY 2007) is funneled towards life sciences (which include agricultural, biological, and medical research components). Nearly 70 percent of that is directed towards medical sciences, particularly driven by the University of Maryland, Baltimore. Biological sciences are funded by all area institutions, while an agricultural science is funded at UMCP.

See Appendix II for R&D funding by study area educational institutions.

6.2 Local Technology Transfer Activity

University licensing activity provides an indication of technology transfer from academia to private industry. The Association of University Technology Transfer Managers (AUTM) estimates that in 2005, higher education institutions in the study area (UMCP, UMB and UMBC, plus Georgetown University) executed a total of 87 licenses and options and received nearly $15 million in licensing income. According to this data (Appendix V) 12 licenses and options were executed to start-up companies in 2005.

6.2.1 Patent Issuance for University of Maryland System and Georgetown University

Patenting activity offers some insights into a region's overall commercialization capacity and performance. By granting exclusive rights to commercialize an

[38] Rothenburg, Karen, Maryland Stem Cell Research Commission, "Maryland Stem Cell Research Fund", February 27, 2009.

invention, patents provide inventors and licensees a degree of competitive advantage. Patents reflect the proven capacity of regional firms to develop new products and processes.

Patent data needs to be contextualized because they are often pursued solely as a legal strategy not tied to any specific commercialization plans. Also, the existence of a patent tells little about whether or how frequently the patented technology is being used. Because patents typically issue several years after the technology is invented, patenting is a lagging indicator of research activity. Moreover, there is no guarantee that the production will take place within the region. Finally, the presence of large companies that file large numbers of applications can skew the data, as can the presence of corporate headquarters (which tend to be colocated with R&D facilities). Most of the metrics used in this report can be viewed as innovative inputs i.e., assets supporting research activities and commercialization outcomes. Licensing, however, is a fairly robust indicator of the level of technology transferring out of research institutions and into the commercial sector".[39]

6.2.2 Types of Patents

There are three types of patents[40:]

1) **Utility patents** may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof.

2) **Design patents** may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture; and

3) **Plant patents** may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant."

[39] Technology Commercialization in Greater Washington, Potomac Conference Technology Transfer Task Force. January 2004.

[40] U.S. Patent and Trademark Office web site access in August 2007.

Number of Utility Patents Assigned Annually

	UMCP	Georgetown University	UMD Biotechnology Center	UMD School of Medicine	TOTAL
PRE-1985	7	17	0	0	24
1985	1	1	0	0	2
1986	2	0	0	0	2
1987	5	4	0	0	9
1988	3	3	0	0	6
1989	4	1	0	0	5
1990	11	5	0	0	16
1991	13	3	0	2	18
1992	27	5	0	0	32
1993	19	5	0	0	24
1994	18	7	2	0	27
1995	29	6	3	0	38
1996	20	7	4	0	31
1997	29	8	7	0	44
1998	28	11	3	0	42
1999	27	8	8	0	43
2000	33	13	13	0	59
2001	23	8	5	0	36
2002	22	8	3	0	33
2003	11	12	2	0	25
2004	2	9	0	0	11
2005	0	1	0	0	1

Total	**334**	**142**	**50**	**2**	**528**

Source: U.S. Patent and Trademark Office (PTO)

The number of utility patents assigned is often used as a technology commercialization indicator, as utility patents are the first step in commercialization.

As seen from the above table, UMCP led all other universities in this study in the number for utility patents received through 2005. It should be noted that these utility patents are not categorized according to the type of technology or scientific area. But, the level of activity is a measure of the robustness of the technology transfer operation at UMCP.

The UMCP Office of Technology Transfer was able to provide a more detailed breakdown for the years 2003-2007 than the Patent and Trademark Office. The number and type of patents reported by the UMCP Technology Transfer Office is additive and does not correlate directly to the U.S. Patent and Trademark Office (PTO) information in the previous chart.

The University of Maryland's Awarded Utility Patents by Type			
Fiscal year	**Life Sciences**	**Information Sciences**	**Physical Sciences**
2003	16	0	12
2004	8	2	13
2005	12	5	8
2006	12	4	11
2007	11	6	10
TOTAL	**59**	**17**	**54**

Source: University of Maryland, Office of Technology Commercialization

UMD has been a national leader in utility patents. As illustrated in the table below, the university ranked among the top 15 U.S. universities for receiving utility patents for invention in 2003.

U.S. Universities Receiving the Most Utility Patents for Invention in 2003

Preliminary Rank in 2003*	Preliminary Number of Patents in 2003*	U.S. University	(Final Rank in 2002)	(Final Number of Patents in 2002)
1	439	University of California	(1)	(431)
2	139	California Institute of Technology	(3)	(110)
3	127	Massachusetts Institute of Technology	(2)	(135)
4	96	University of Texas	(5)	(93)
5	85	Stanford University	(4)	(104)
6	84	University of Wisconsin	(6)	(81)
7	70	Johns Hopkins University	(6)	(81)
8	63	University of Michigan	(12)	(47)
9	61	Columbia University	(13)	(45)
10 **	59	Cornell University **	(21)	(35)
**	59	University of Florida **	(15)	(42)
12	52	Pennsylvania State University	(9)	(50)
13	49	Michigan State University	(10)	(49)
14	45	University of Maryland	(25)	(31)
15	44	North Carolina State University	(23)	(33)

*The listed patent counts are preliminary. The final listing of patent counts for U.S. universities in 2003 should be available in late December of 2004.

** Indicates a tie in the ranking among two or more U.S. universities.

Source: U.S. Patent and Trademark Office

6.3 Employment Analysis

This study relies upon the Governor's Workforce Investment Board's (GWIB) industry definition of bioscience, which includes the following industries:

- Pharmaceutical and Medicine Manufacturing (NAICS code 3254)
- Irradiation Apparatus Manufacturing (334516)
- Analytical Lab Instrument Manufacturing (334517)
- Surgical Appliance and Supplies Manufacturing (339113)
- Testing Labs (541380)
- Environmental Consulting Services (541620)
- R&D Physical, Engineering, & Life Sciences (541710)

Between 2000 and 2006, bioscience employment in the study area has grown at an average annual pace of 6.3 percent and employs more than 28,700 workers. Although the industry comprises just 1.2 percent of the aggregate employment base for the region, growth has accelerated rapidly in recent years and far outpaces the 0.6 percent average annual growth for the region's aggregate employment base.

Roughly 42 percent of the region's bioscience employment base is concentrated in Montgomery County, with another 21 percent in Howard County. With employment of 1,573, Prince George's County is home to 5.5 percent of the region's bioscience employment. Unlike Howard and Montgomery Counties, which had steady increases, Prince George's County's bioscience employment level fluctuated over the six year period between 2000 and 2006. (See table below.) The development of a bioscience workforce must be a critical element in the county's overall planning for successfully developing a bioscience cluster. One key will be to build on existing resources within the technology generators in the county and to develop innovative partnerships for workforce development.

Bioscience Employment in the Study Area

	Anne Arundel County	Baltimore County	Howard County	Frederick County	Montgomery County	Prince George's County	Total
2000	1,477	2,986	3,948	79	8,553	1,756	18,799
2001	1,531	4,245	4,556	2,263	9,792	1,709	24,096
2002	1,645	4,580	5,032	2,319	10,801	1,589	25,966
2003	1,687	4,369	5,020	2,517	10,851	1,674	26,118
2004	1,821	4,663	5,778	1,518	11,013	1,713	26,506
2005	1,907	4,554	5,838	1,396	11,659	1,781	27,135
2006	1,859	4,636	6,048	2,557	12,115	1,573	28,788

Source: RESI, Bureau of Labor Statistics, Quarterly Census of Employment & Wage data.

The largest component of the region's overall bioscience industry is R&D, physical engineering and life sciences, which comprise 72 percent of area bioscience employment. According to the North American Industry Classification System (NAICS)[41], this industry includes: "establishments primarily engaged in conducting research and experimental development in the physical, engineering, and life sciences, such as agriculture, electronics, environmental, biology, botany, biotechnology, computers, chemistry, food, fisheries, forests, geology, health, mathematics, medicine, oceanography, pharmacy, physics, veterinary, and other allied subjects". Pharmaceutical and medicine manufacturing comprises another 15 percent, followed by testing labs (6.2 percent) and environmental consulting services (6.0 percent).

6.4 Bioscience Clustering and Best Practice

"Today's economic map of the world is dominated by clusters—critical masses in one place of unusual competitive success in a particular field. Clusters are not unique…and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things—knowledge, relationships, motivation—that distinct rivals cannot match…"

Michael E. Porter
"Clusters and the New Economics of Competition"

[41] North American Classification System, United States, 2002. Office of Management and Budget.

Bioscience clusters are an emerging opportunity for some regions. Conventional wisdom states that successful bioscience clusters today generally are those where bioscience research and development is concentrated. However, these may not be the only industry clusters in a given region. These clusters may not all be mature clusters. Many are still developing. The definitions dramatically affect characterization of clusters. Too narrow a definition represents potential lost opportunities for states, regions, and counties. Many new niche markets, such as nanotechnology, bioinformatics, bioengineering, food safety and vaccine development have not already been captured by existing cluster locations. This is especially true in Maryland, where Montgomery County, Frederick County, Baltimore County and the City of Baltimore are developing distinct bioscience clusters based on their competitive advantages. Clusters do not appear suddenly, they develop over time.

A review of national bioscience clustering case studies indicates that the key characteristics of bioscience cluster development are:

- Anchor firms/organizations/facilities
- Synergies among talent, technology and capital needs that enable firms to start, expand and grow
- Opportunities for collaboration and connectivity
- Research and development center, business accelerators and research parks can help address these issues directly and indirectly

Many factors contribute to the successful development of a bioscience cluster, including technology, capital and talent. Bioscience cluster development is typically anchored by academic health and medical organizations or higher education research organizations. The presence of a strong research base is a prerequisite for forming a cluster. Increasingly, this research base focuses on niches that are multi-disciplinary and increasingly multi-institutional.

7. Assessment of Development Elements

The ANGLE Team developed a data framework for evaluation of the sites, based on project related research and the stakeholder interview program (See Appendix VIII). This framework incorporates a combination of specific elements relevant to Prince George's County and best practice site selection.

7.1 Decision Criteria

To provide practical context for each site under consideration, a data framework has been created, which consists of five broad categories of variables that impact facility location decision:

Physical features

- Proximity to technology generators, road and Metro access, acreage available, ownership, zoning and time to rezone, infrastructure requirements, as well as site and community development issues

Program features

- Access to strategic research partners, access to commercialization resources, proximity to financial resources, networking/collaboration potential

Business features

- Access to strategic business partners, business mentors and equipment

Financial features

- Funding options, set-up time, cost of land

Political features

- Political support and consistency with county government positions

7.2 Decision Tool for Location Analysis

Using this data, ANGLE developed a decision making tool using the five categories of features above for location analysis. The tool is a flexible, Excel-based analytical tool to facilitate discussion and trade-off decisions. The tool was used to create the location scorecard which is illustrated in Section 9.

.

8. Identification of Suitable Sites

The location of the BRDC will be a critical element in its success and the location decision must be made carefully. The ANGLE Project Team worked closely with M-NCPPC planning staff to identify six preliminary sites for near-term consideration. A seventh site was selected for longer- term consideration.

8.1 Criteria for the Identification of Preliminary Sites

. The general physical criteria used to identify sites were:

- A site located within approximately five miles of the University of Maryland-College Park, the primary technology generator for the project
- A site 5 to 15 acres in size
- A site owned by Prince Georges County or M-NCPPC
- A site located at or near one of the Metro stops in the county
- A site with good road access

8.2 Identified Sites

Following a review of numerous county data sources, and the physical criteria outlined above, M-NCPPC staff compiled a list of six preliminary sites for evaluation. The following vicinity map indicates the location of these sites. Addresses and additional information about the sites are included in the next section.


LEGEND
Red Line - Shady Grove to Glenmont
Blue Line - Addison Road to Franconia - Springfield
Orang Line - Vienna/Fairfax - GMU to New Carrollton
Yellow Line - Mount Vernon Square - UDC to Huntington
Green Line - Greenbelt to Branch Avenue
Penn Line
Brunswick Line
Camden Line
Station
Station
Transfer Station
Proposed Line
Existing Line
VRE Commuter Rail Service
AMTRAK Antrak Service
SITES
1. Campus Village Shopping Center
2. West Hyattsville Metro
3. Cafritz Property
4. Prince George's Plaza
5. M-Square
6. Konterra
7. UDC & Howard
BIOTECHNOLOGY RESEARCH AND DEVELOPMENT CENTER-PRELIMINARY SITES
MONTGOMERY COUNTY
Shady Grove
Rockville AMTRAK MARC
Glenmont
White Flint
Forest Glen
Medical Center
COLLEGE PARK
Greenbelt MARC
BELTSVILLE AGRICULTURAL RESEARCH CENTER
Takoma
Prince George's Plaza
New Carrollton
New Carrollton AMTRAK MARC
WASHINGTON, DC
Friendship Heights
POTOMAC
RIVER
MARYLAND
VIRGINIA
FAIRFAX COUNTY
Fort Totten
Brookland CUA
Woodley Park-Zoo/Adams Morgan
Shaw-Howard University
Landover
Deanwood
Morgan Boulevard (Site)
Largo Town Ctr (Site)
Union Station AMTRAK MARC VRE
ARLINGTON COUNTY
Rosslyn
Arlington Cemetery
FALLS CHURCH
Ballston-MU
Capitol Heights
Navy Yard
Waterfront SE U
Pentagon
Pentagon City
Anacostia
PRINCE GEORGE'S COUNTY
National Airport
Southern Ave
Branch Ave
ALEXANDRIA
Braddock Rd
Van Dorn Street
Hunington
Franconia-Springfield VRE
N
270
95
295
495
50
395

8.3 Site Summaries: Physical, Planning and Infrastructure

Summaries for each site follow. The zoning and water/sewer categories used in these summaries are defined in the Glossary of Selected Terms in Appendix IX.

Site 1:	Campus Village Shopping Center
Address	8133-8153 Baltimore Avenue College Park, MD
Tax Acct. No.	2359479, 2359461, 2409787, 2359453, 2396083
Acreage	2.8 acres
Type	Developed (Shopping center and other commercial uses)
Ownership	Private: ▪ Campus Village SCJV - Lots 3, 4, 5, 7, 10, and 11 ▪ Peter Chong – Lot 6 ▪ Burdoo Enterprises, LLC – Lots 8 and 9
Site Information	
Topo	Flat
Water & Sewer	W-3, S-3
Zoning	M-U-I and D-D-O
Access	US 1
Metro	Approximately one mile from College Park Metro station
District	Councilmanic District 3
Comments	Land assembly needed

Site 2:	West Hyattsville Metro
Address	5620 Ager Road Hyattsville, MD
Tax Acct. No.	1901966
Acreage	18.4 acres
Type	Developed (Vacant warehouse and Metro tracks)
Ownership	Private: Gunston Hall Realty, Inc.
Site Information	
Topo	Flat
Water & Sewer	W-3, S-3
Zoning	M-X-T and T-D-O
Access	Ager Road
Metro	Adjacent to the West Hyattsville Metro station
District	Councilmanic District: 2
Comments	Metro tracks go through the property

Site 3	Cafritz Property
Address	6667 Baltimore Avenue Riverdale Park, MD
Tax Acct. No.	2128080, 2128106, 2128072
Acreage	36.12 acres
Type	Undeveloped
Ownership	Private: Calvert Tract LLC
Site Information	
Topo	Hilly
Water & Sewer	W-3, S-3
Zoning	R-55
Access	US 1
Metro	One mile from College Park Metro station and 1.3 miles from Prince George's Plaza Metro station
District	Councilmanic District: 3
Comments	Owner is actively looking for development alternatives and shows interest in R&D type of use

Site 4	Prince Georges Plaza Metro
Address	3308 Toledo Road Hyattsville, MD
Tax Acct. No.	1865732, 1865740, 1865757
Acreage	19.7 acres (12 acres buildable area)
Type	Partially developed (parking lot)
Ownership	Private: LC Dewey
Site Information	
Topo	Flat (buildable area)
Water & Sewer	W-3, S-3
Zoning	M-X-T and T-D-O
Access	Toledo Road and Belcrest Road
Metro	Half a mile from Prince George's Plaza Metro Station
District	Councilmanic District: 2
Comments	Because of steep slopes, only 12 acres are buildable

Site 5	M-Square (Phase I)
Address	Paint Branch Parkway and Cpl Frank S. Scott Drive, College Park, MD
Tax Acct. No.	2358620, 2358539, 2358547, 2358554, 2358562, 2358570, 2358588, 2358596, 2358604, 2358612, 2358521, 2358638, 2359149, 2358802, 2358877
Acreage	2.16 acres
Type	Developed (surface parking lot)
Ownership	Public: Prince Georges County
Site Information	
Topo	Flat
Water & Sewer	W-3, S-3
Zoning	M-X-T and T-D-O
Access	Paint Branch Parkway
Metro	Across from the College Park Metro station
District	Councilmanic District: 3
Comments	Small site; county ownership is a plus

Site 5	M-Square (Phase II)
Address	Paint Branch Parkway and Cpl. Frank S. Scott Drive, College Park, MD
Tax Acct. No.	2358851 (Prince Georges County); 2362440 (M-NCPPC)
Acreage	3.91 acres
Type	Developed (tennis bubbles)
Ownership	Public: Prince Georges County and M-NCPPC
Site Information	
Topo	Flat
Water & Sewer	W-3, S-3
Zoning	M-X-T and T-D-O
Access	Paint Branch Parkway
Metro	Across from the College Park Metro Station
District	Councilmanic District: 3
Comments	Long-term lease exists with a private operator of the tennis bubbles.

Site 6	Konterra Business Campus
Address	7000 Muirkirk Meadows Drive Laurel , MD
Tax Acct. No.	3373503
Acreage	10.17 acres
Type	Undeveloped (previous structure closed and demolished)
Ownership	Private: 1111 19th Street Associates
Site Information	
Topo	Rolling
Water & Sewer	W-3, S-3
Zoning	E-I-A
Access	Muirkirk Meadows Drive
Metro	None.
District	Councilmanic District: 1
Comments	Close to Intercounty Connector and I-95. Close to MARC Train station.

A seventh site, the University of the District of Columbia and Howard University (North Campus) site in Beltsville, also was identified by M-NCPPC staff, but was not included as part of the Location Selection Scorecard analysis. However, it is mentioned in this report as a potential, long-term location option for the expansion of the county's biotechnology program.

Site 7	University of the District of Columbia and Howard University (North Campus)
Address	7501 Muirkirk Road Beltsville, MD
Tax Acct. No.	0017368, 3230638, 0029496
Acreage	252.28 acres
Type	Undeveloped (Lot 175-Howard University) Partially developed (residential) (Lot 180-University of the District of Columbia)
Ownership	Public and Private: University of the District of Columbia and Howard University
Site Information	
Topo	Rolling
Water & Sewer	W-3, S-3 (Lot 175). W-6, S-6 (Lot 180)
Zoning	O-S
Access	Old Baltimore Road and Muirkirk Road
Metro	None.
District	Councilmanic District: 1
Comments	Howard University has a general interest in developing the site and would like to discuss partnering with the county on the BRDC project.

9. Location Selection Scorecard

The site summary information detailed in Section 8 was analyzed using the decision criteria for a BRDC to create the Location Selection Scorecard below. The scorecard is a flexible, analytical tool that facilitates trade-off decisions. It creates rankings using weighted analytical criteria or measures: physical and program features, business resources, plus financial and political considerations.

The scorecard analysis indicates that the top three sites are in order:

- M-Square
- Konterra Business Campus
- Prince George's Plaza Metro

The M-Square site ranked highest because of its physical proximity to UMCP and the access that the site has to research and commercialization partners associated with the university, which are critical requirements particularly for formative bioscience companies. The site also received high scores for its Metro access. This access is important today and it could be extremely important in the future, if Metro's proposed Purple Line is constructed. The Purple Line would connect College Park Metro station directly with NIH at the Medical Center Metro station. In addition, the M-Square site is the only site owned by Prince George's County, which would reduce the cost of development at the site.

The Konterra Business Campus and Prince George's Plaza Metro sites ranked second and third respectively and their scores were very close. Of the three sites, Konterra is located the farthest away from UMCP and the closest to USDA-BARC. Although it has no Metro access, it has access to MARC commuter train station and good highway access. It is also close to several of the county's existing biotechnology companies. This highway access is likely to become even better when the Intercounty Connector (ICC) is built. The interchange for the ICC at I-95 is very close to the Konterra site evaluated. The Konterra site is the largest site, with the most commercial development potential. The Prince George's Plaza Metro site is not located as close to the university as the M-Square site however, it is in the Prince George's Plaza Transit District Overlay Zone (TDOZ) and adjacent to the University Town Center where the Center for Disease Control and Prevention has offices. The cost of land at this site would be relatively high.

The Location Selection Scorecard appears below. The scoring system used is:

1 = Poor 2 = Average 3 = Good 4 = Excellent

Biotechnology Research and Development Center
Location Selection Scorecard

			Site					
	Measure	Weight	1 Campus Village	2 West Hyattsville Metro	3 Cafritz Property	4 Prince George's Plaza Metro	5 M-Square	6 Konterra Business Campus
Physical Features	Proximity to technology generators	4	3	2	3	3	4	2
	Road access	3	3	2	3	3	3	4
	Metro access	4	3	4	3	4	4	1
	Acreage available	3	1	3	4	3	1	3
	Land ownership (Public/Private)	4	1	2	2	2	4	2
	Zoning/Infrastructure required	2	1	3	3	3	3	4
	Site and community development issues	2	1	3	3	3	1	4
Program Features	Access to strategic research partners	3	4	3	2	3	4	2
	Access to commercialization resources	3	2	3	3	3	4	3
	Proximity to financial resources	3	2	3	2	3	4	3
	Networking / collaboration potential	3	3	3	2	3	4	2
Business Resources	Access to strategic business partners	4	4	3	3	3	4	3
	Access to business mentors & equipment	4	4	2	2	3	4	2
Financial	Funding options	3	2	2	2	2	3	2
	Set-up time	4	1	1	1	1	2	4
	Cost of land	4	1	1	3	1	4	3

Aggregate Score	123	129	134	140	181	141
Normalized Score	14.5	15.2	15.8	16.5	21.3	16.6
Rank	6	5	4	3	1	2

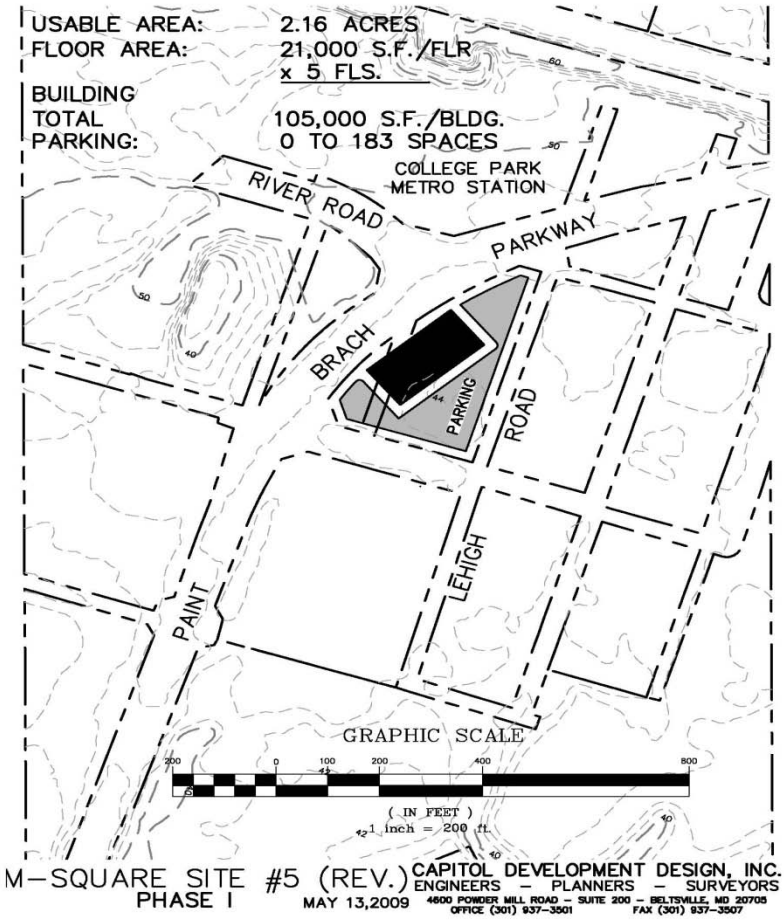
10. Development Analysis of Top Three Sites

The bubble diagrams prepared for each of three highest ranking sites provide preliminary information on how the sites could be developed. In each case, the parking configuration will need to be reworked slightly, as the configurations currently shown do not conform to the county's zoning ordinance requirements.

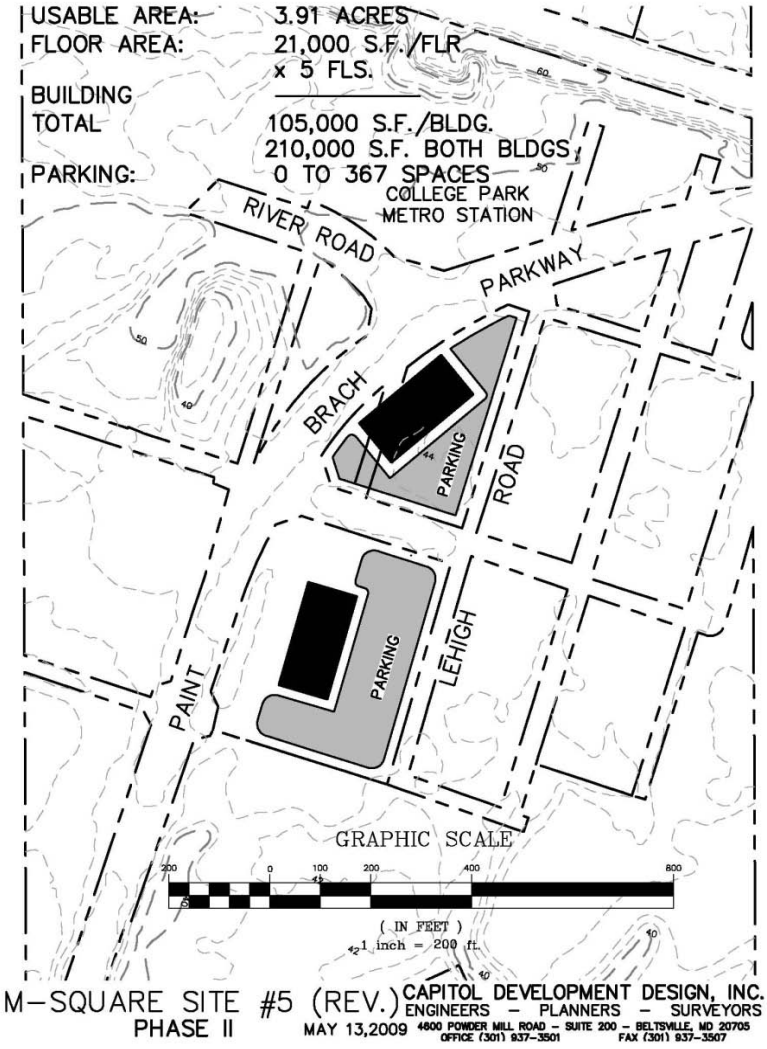
10.1 M-Square Site

The following diagrams represent a two-phase approach to the development of this site. The initial facility (Phase I) could be constructed on county-owned property. A second facility could be constructed (Phase II) on adjacent property that is controlled by M-NCPPC but currently under a long-term lease arrangement to provide athletics facilities.

Phase I: Develop the first BRDC facility on county-owned property.



Phase II: Develop the second BRDC facility on adjacent property controlled by M-NCPPC but under a long term commercial lease.



10.1.1 M-Square Site Analysis

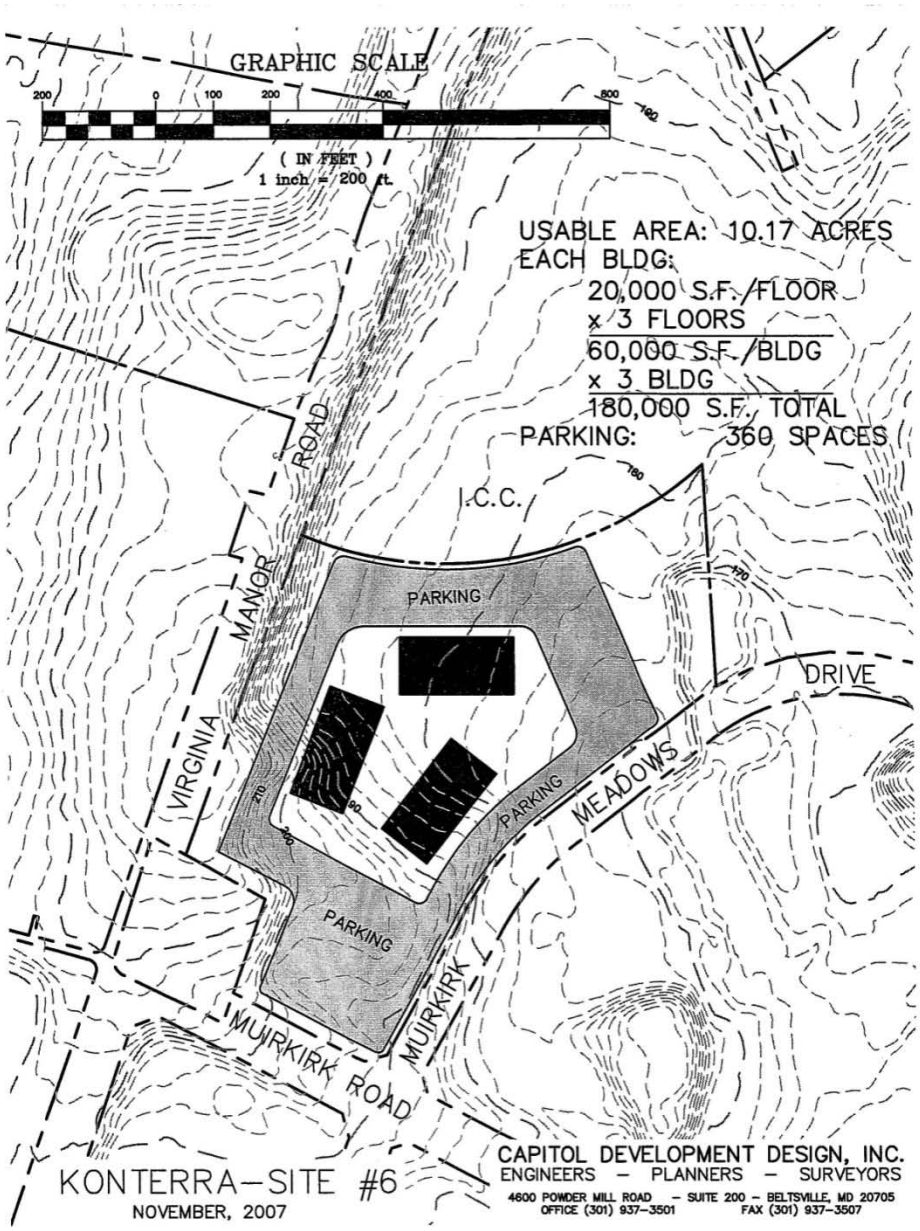
Located in a Transit District Overlay Zone (TDOZ), this site is currently zoned for high density development consistent for a site near a Metro station. The major street fronting the property is Paint Branch Parkway, which exists. The interior street, Lehigh Road would need improvement. There is a street through the Phase I site, which should be abandoned along with the recorded lots on part of the property.

The current use of county-owned Phase I site is for surface parking and Phase II site is tennis structures. The bubble diagrams for the site, which appear above, fully utilize the site. The Phase II site is owned by M-NCPPC and the county. This property is currently leased by M-NCPPC to a private entity for tennis structures. Any relocation of the tennis structures would seriously impact the tennis playing community and would need to be agreed with M-NCPPC.

The primary environmental issue is that the site is located in the Paint Branch flood plain as shown on the PG Atlas web site. A flood plan study is suggested to see if there is a serious problem with the site. There does not appear to be any other impact.

The assessed land value for the total proposed six-acre development site, owned in part by the county and in part by M-NCPPC was $1,604,700 as of 1/1/2007.

10.2 Konterra Business Campus Site



10.2.1 Konterra Site Analysis

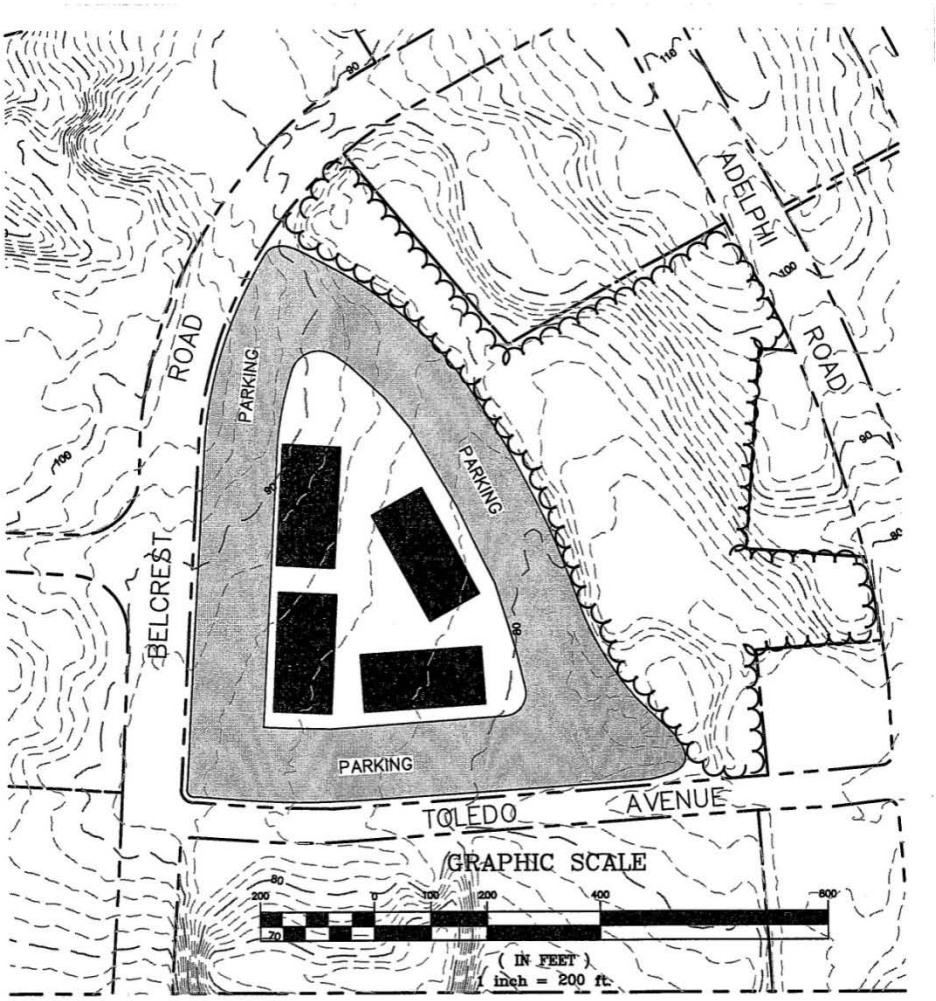
This site is part of a larger planned community and employment center. It is zoned Employment and Institutional Area (E-I-A), which is consistent with the proposed use. The lot is situated in an area of existing buildings and a major employment center.

Road access is good and will be great once the Intercounty Connector (ICC) is built. The ICC is adjacent to the property at an interchange. The ICC will connect to a new interchange at I-95.

No major environment issues exist on the property. The proposed use would have minimal impact on the surrounding neighborhood. In fact, this site is located near a small existing cluster of the county's life science companies (Baxter, Metamorphix and BioServe). This is also the closest site analyzed in this study to the 200-acre site owned by the University of the District of Columbia and Howard University (North Campus) which has been mentioned as a potential site for a technology park in the county.

The assessed land value for this 10-acre site is $2,981,600 as of 1/1/2007.

10.3 Prince George's Plaza Metro Site



PRINCE GEORGE'S PLAZA–SITE #4
NOVEMBER, 2007

CAPITOL DEVELOPMENT DESIGN, INC.
ENGINEERS – PLANNERS – SURVEYORS
4600 POWDER MILL ROAD – SUITE 200 – BELTSVILLE, MD 20705
OFFICE (301) 937–3501 FAX (301) 937–3507

USABLE AREA:	19.7 ACRES
EACH BLDG.:	20,000 S.F./FLR
	x 6 FLRS
	120.000 S.F./BLDG
TOTAL FLOOR AREA:	480,000 S.F.
PARKING:	0 TO 1,200 SPACES

10.3.1 Prince George's Plaza Metro Site Analysis

Located in a Transit District Overlay Zone (TDOZ), this site is currently zoned for mixed-use, which would accommodate the proposed BRDC. The major streets are also built with frontage on the property.

Environmental issues exist on the site due to drainage flow through the site. The area is wooded and is in a conservation area, per the master plan. Due to these restrictions the buildable area of the 19.7-acre site is reduced to 12 acres. The existing use on the property is a parking lot. Impact on the neighborhood would be additional buildings in an already heavily developed area. As the site has been planned for such use, the proposed development should have minimal impact on the surrounding neighborhood.

The assessed land value for this approximately 19.7-acre site is $8,038,700 as of 1/1/2007.

11. Economic Feasibility Analysis for Three Locations

A five year financial model for each of the three proposed BRDC sites was developed. These financial projections should be viewed as illustrative and nothing further as many of the assumptions and underlying basis could change with each site selected. A series of assumptions underlie the projections. These assumptions are detailed in the tables below.

	Konterra Business Campus	M-Square	Prince George's Plaza
Total SF	180,000	210,000	480,000
Rentable Area	153,000	178,500	408,000
# Floors	3	5	6
# Bldgs	3	2	4
SF/bldg	60,000	105,000	120,000
SF/floor	20,000	21,000	20,000
Full Build-out	15 years	10 years	20 years
Retail Space	51,000	35,700	68,000
Wet Lab Space	51,000	71,400	170,000
Office Space	51,000	71,400	170,000
Rent			
Retail Space	$ 40.00	$ 40.00	$ 40.00
Wet Lab	$ 32.00	$ 32.00	$ 32.00
Office Space	$ 25.00	$ 25.00	$ 25.00
Annual Rent Increase	3%	3%	3%
Retail Space CAM/SF	2.75	2.75	2.75
Bad debt	0.50%	0.50%	0.50%

The size and rent table above provides details on the size and distribution of space assumed in the analysis. In addition, estimates for market based rents were used, as well as assumptions regarding the annual rent increase and bad debt allowance. The former assumption was drawn from long-term growth in the Consumer Price Index (CPI) and the latter was based on the experiences of Montgomery County. We assumed that for each building, at least one full floor would have a retail component to it. The mix of retail could consist of store fronts such as dry cleaning, banking, drug store, deli counter, etc.

Occupancy Rates

(in percent)

	Year 1	Year 2	Year 3	Year 4	Year 5
Retail Space	70	80	90	90	90
Wet Lab	70	80	90	90	90
Office Space	50	60	70	80	90

The Occupancy Rates Table above details the projected occupancy rates of each the building by type of usage. These assumptions are based on the experiences of other facilities. We assumed that by year five, full occupancy (90%) would be achieved.

The Expenses Table below illustrates the various cost components typically associated with operating a building. These costs are based upon other projects and are representative and should be viewed in that manner. We have reported these expenses on a per square foot basis so that we can apply them to the three building sites.

Expenses

Category	Cost/SF
Administrative	
Office Supplies	$0.04
Phone and Internet Service	$0.04
Postage	$0.01
Dues and Subscriptions	$0.03
Catering-programmatic/other	$0.07
Advertising & Marketing	$0.11
Insurance	$0.22
Accounting Fees	$0.15
Legal Fees	$0.04
Lab Compliance and Safety fees	$0.22
Real Estate Taxes	$3.06
Repair & Maintenance	
Exterminating Service	$0.04
Fire Protection	$0.04
Maintenance Engineer	$0.61
R & M Various	$0.11
Shared Equipment Maintenance	$0.11
Cleaning	
Trash Removal	$0.08
Janitorial-common areas only	$0.14
Window Washing	$0.01
Landscaping & Grounds	
Planting and Maintenance	$0.07
Snow Removal	$0.02
Utilities	
Electricity	$6.50
Water & Sewer	$0.11
Gas	$0.22

We have combined our assumptions about potential revenues from rent and on-going state and/or local support with the various expenses to arrive at a net income for each site. The following tables present our findings for each for the first five years. We have also made several assumptions regarding the level of staffing and programs that

could be offered through the space. We assumed two full time equivalents for staffing the building. We have assumed that a TAP LITE program will be offered to the tenants as this space is designed to be the bridge between the incubator and commercial space.

Our findings indicate that within the first five years of operations based upon reasonably conservative assumptions, each site will generate a positive net income.

M-Square	$273,946 (Year 1)
Konterra Site	$181,744 (Year 1)
Prince George's Plaza Metro	$275,160 (Year 1)

Financial models for each of the sites appear on the following pages.

M-Square[42]

	Year 1	Year 2	Year 3	Year 4	Year 5
Income					
Potential Lab Rental Income ($32/sf)	$799,680	$941,338	$1,090,775	$1,123,498	$1,157,203
Potential Office Rental Income ($25/sf)	$446,250	$551,565	$662,797	$780,207	$904,065
Retail Space Rental ($40/sf)	$499,800	$588,336	$681,734	$702,186	$723,252
Additional Funding					
State Grants (TEDCO)	$50,000				
County Grants	$100,000	$100,000	$100,000	$100,000	$100,000
Local Grants	$50,000	$50,000	$50,000	$50,000	$50,000
Other Contributions					
Subtotal Income	$1,945,730	$2,231,239	$2,585,306	$2,755,891	$2,934,520
Expenses					
Labor					
Client Coordinator	$46,550	$48,412	$50,348	$52,362	$54,457
Facilities Manager	$126,350	$131,404	$136,660	$142,127	$147,812
Contract Services-TAP LITE	$60,000	$61,800	$63,654	$65,564	$67,531
Administrative	$51,729	$49,396	$52,186	$54,089	$56,064
Real Estate Taxes[43]	$321,640	$331,289	$341,228	$351,465	$362,009
Repair & Maintenance	$81,320	$83,760	$86,273	$88,861	$91,527
Cleaning	$185,688	$191,259	$196,996	$202,906	$208,994
Landscaping & Grounds	$9,061	$9,333	$9,613	$9,902	$10,199
Utilities	$716,481	$737,975	$760,114	$782,918	$1,612,810
Asset Management Fee (@3%)	$58,372	$66,937	$77,559	$82,677	$88,036
Replacement Reserves (0.75%)	$14,593	$16,734	$19,390	$20,669	$22,009
Subtotal Expenses	$1,671,784	$1,728,299	$1,794,021	$1,853,540	$2,721,448
Net Income	**$273,946**	**$502,940**	**$791,285**	**$902,351**	**$213,072**

[42] Numbers may not add up due to rounding.

[43] The estimated real estate taxes are for the entire anticipated square footage to be built at each location.

Konterra Business Campus[44]

	Year 1	Year 2	Year 3	Year 4	Year 5
Income					
Potential Lab Rental Income ($32/sf)	$380,800	$448,256	$519,417	$534,999	$551,049
Potential Office Rental Income ($25/sf)	$212,500	$262,650	$315,618	$371,527	$430,507
Retail Space Rental ($40/sf)	$476,000	$560,320	$649,271	$668,749	$688,811
Additional Funding					
State Grants (TEDCO)	$50,000				
County Grants	$100,000	$100,000	$100,000	$100,000	$100,000
Local Grants	$50,000	$50,000	$50,000	$50,000	$50,000
Other Contributions					
Subtotal Income	$1,269,300	$1,421,226	$1,634,306	$1,725,275	$1,820,367
Expenses					
Labor					
Client Coordinator	$46,550	$48,412	$50,348	$52,362	$54,457
Facilities Manager	$126,350	$131,404	$136,660	$142,127	$147,812
Contract Services-TAP LITE	$60,000	$61,800	$63,654	$65,564	$67,531
Administrative	$48,347	$45,346	$47,431	$48,936	$50,494
Real Estate Taxes	$183,794	$189,308	$194,987	$200,837	$206,862
Repair & Maintenance	$54,214	$55,840	$57,515	$59,241	$61,018
Cleaning	$106,107	$109,291	$112,569	$115,946	$119,425
Landscaping & Grounds	$5,178	$5,333	$5,493	$5,658	$5,828
Utilities	$409,417	$421,700	$434,351	$447,382	$460,803
Asset Management Fee (@3%)	$38,079	$39,221	$40,398	$41,610	$42,858
Replacement Reserves (0.75%)	$9,520	$9,805	$10,100	$10,402	$10,715
Subtotal Expenses	$1,087,556	$1,117,460	$1,153,506	$1,190,065	$1,227,803
Net Income	**$181,744**	**$303,766**	**$480,800**	**$535,210**	**$592,564**

[44] Numbers may not add up due to rounding.

Prince George's Plaza Metro[45]

	Year 1	Year 2	Year 3	Year 4	Year 5
Income					
Potential Lab Rental Income ($32/sf)	$952,000	$1,120,640	$1,298,542	$1,337,498	$1,377,623
Potential Office Rental Income ($25/sf)	$531,250	$656,625	$789,044	$928,818	$1,076,268
Retail Space Rental ($40/sf)	$476,000	$560,320	$649,271	$668,749	$688,811
Additional Funding					
State Grants (TEDCO)	$50,000				
County Grants	$100,000	$100,000	$100,000	$100,000	$100,000
Local Grants	$50,000	$50,000	$50,000	$50,000	$50,000
Other Contributions					
Subtotal Income	$2,159,250	$2,487,585	$2,886,857	$3,085,065	$3,292,702
Expenses					
Labor					
Client Coordinator	$46,550	$48,412	$50,348	$52,362	$54,457
Facilities Manager	$126,350	$131,404	$136,660	$142,127	$147,812
Contract Services-TAP LITE	$60,000	$61,800	$63,654	$65,564	$67,531
Administrative	$52,796	$54,688	$52,674	$54,685	$56,774
Real Estate Taxes	$367,589	$378,616	$389,975	$401,674	$413,724
Repair & Maintenance	$108,427	$111,680	$115,030	$118,481	$122,036
Cleaning	$212,215	$218,581	$225,139	$231,893	$238,850
Landscaping & Grounds	$10,356	$10,667	$10,987	$11,316	$11,656
Utilities	$818,835	$843,400	$868,702	$894,763	$921,606
Asset Management Fee (@3%)	$64,778	$74,628	$86,606	$92,552	$98,781
Replacement Reserves (0.75%)	$16,194	$18,657	$21,651	$23,138	$24,695
Subtotal Expenses	$1,884,090	$1,952,533	$2,021,426	$2,088,555	$2,157,922
Net Income	**$275,160**	**$535,052**	**$865,431**	**$996,510**	**$1,134,780**

[45] Numbers may not add up due to rounding.

12. Viability Components

Bioscience research and development centers have been established across the country, using a wide variety of approaches and operational structures. Four representative projects have been selected as illustrations of different approaches:

- A center in its early stage of development with partners that include a research university, a college and an economic development organization
- A disease-focused foundation and a local college organized at the county level
- A university-based center offering research, education, training and laboratory services
- An independent nonprofit corporation with seed funding from the county and chamber of commerce

The information on these projects includes documentation of interviews conducted with principal managers of the organizations that identified critical elements for their formation, growth and viability.

12.1 Example: Central New York Biotechnology Research Center

The Central New York Biotechnology Research Center (CNY BRC) is an example of a **public-private partnership for economic development** with a focus on biotechnology. The partners combine two educational institutions and an economic development organization. They are:

- The State University of New York Upstate Medical University (SUNY Upstate)
- The State University of New York College of Environmental Science and Forestry (SUNY ESF)
- The Metropolitan Development Association of Syracuse and Central New York

To achieve its economic development objectives, the Center focuses on the commercialization of the research conducted at the university and college by providing facilities for product and process development and demonstration.

Under the leadership of John Fieschko, PhD, with 25 years experience in the biotechnology industry, the CNY BRC has raised approximately $25 million from state, federal and private sources. The CNY BRC is utilizing these funds to:

- Create and support biotechnology educational and research programs with its major academic partners, SUNY Upstate and SUNY ESF.
- Develop research and business alliances between existing biotechnology oriented companies primarily in New York State and local academic institutions
- Design and build a biotechnology research center in Syracuse.

The organization owns a wide variety of equipment (autoclaves, laminar flow hoods, microbial and mammalian cell culture bioreactors, downstream harvesting equipment and protein purification equipment) reagents and expertise in the areas of recombinant gene expression in bacterial and mammalian hosts, microbial fermentation and mammalian cell culture and downstream processing and protein purification. These research tools are temporarily housed at laboratories in SUNY ESF and SUNY Upstate, but will soon be housed in the CNY BRC. The center will house a Bioprocessing Product Development and Demonstration Center where products and devices for bioprocessing from New York State partner companies will be developed, evaluated and demonstrated to customers in fully integrated bioprocesses. The center also includes the Bioprocessing Renewable Resources and Drug Development Center where existing and new biomanufacturing processes will be developed and optimized.

Interview with John Fieschko, Executive Director, October 3, 2007

CNYBRC was conceived by its three principal partners with the assistance of the Bristol Meyers Squibb company in Central New York approximately four years ago. Dr. Fieschko has been on board as Executive Director for the past two years. It is a start-up operation and has been focused initially on developing projects with private companies rather than seeking research grants from federal agencies. For example, Dr. Fieschko has initiated a project with the Corning Corporation and SUNY ESF in filtration technology and fermentation for the production of ethanol. Another project with Corning and the Hilliard Corporation is developing bioreactors for converting waste lactose from cheese production to ethanol. A third project with a private company and the university involves cultivation of mammalian stem cells as a source of cell-derived products.

In addition to developing industry-academia projects, Dr. Fieschko is evaluating several sites, including existing buildings, for a permanent home for the center. The facility would be developed with a $20 million grant from the state.

Critical elements for growth include initial seed funds from the partners and from Bristol Meyers Squibb. Initial funding needs to be sufficient for supporting an executive director and a small staff to write proposals and grant applications to generate cash flow while simultaneously identifying and evaluating sites for a new facility.

12.2 Example: Pennsylvania Biotechnology Center of Bucks County

The Pennsylvania Biotechnology Center of Bucks County is a **partnership between a foundation and an academic institution** created by the Hepatitis B Foundation and Delaware Valley College in 2001 with a $7.9 million grant from the Commonwealth of Pennsylvania. The objectives of the center are to create a world-class biotechnology center, promote regional economic development and job creation and educate and train biotechnology researchers.

The foundation and college originally planned to build an entirely new facility, but received an opportunity to purchase an empty 62,000-square-foot warehouse. The building, which once employed more than 100 workers, was renovated to create state-of-the-art research labs and offices to house nonprofit research organizations and biotech companies.

The center is home to the Hepatitis B Foundation and its research institute, the Institute for Hepatitis and Virus Research, as well as other nonprofit "mission oriented" research organizations, such as the Drexel Institute for Biotechnology and Ben Franklin Technology Partners of Southeastern Pennsylvania. Classroom space is utilized by Delaware Valley College to provide educational opportunities for its students.

Interview with Michael Campbell, PhD., Director of Biotechnology Development, October 4, 2007

The Pennsylvania Biotechnology Center was initiated with a $7.9 million grant from the Commonwealth of Pennsylvania in 2001 and opened its doors in October 2006. The Center was first established on the campus of Delaware Valley College but was later moved to its present site off-campus in a renovated warehouse. It conducts research through the Hepatitis B Foundation's Institute for Hepatitis and Virus Research that is funded largely by grants from NIH. The building and its operation is a 50/50 joint venture between the foundation and the college. It houses foundation offices as well as offices for the Ben Franklin Technology Partners of Southeastern Pennsylvania, the Drexel Institute for Biotechnology and several start-up companies in its incubator facilities. The Ben Franklin organization also provides some funding to support the operations of the center.

The center's economic development mission includes the formation of new companies to commercialize research results, and it supports their growth through incubator facilities and services that include the availability of wet lab space. They also were recently awarded a grant from the federal Economic Development Administration to establish a center for entrepreneurship that will include meeting with pharmaceutical companies and research institutes to identify new technologies with commercial potential. The grant would provide some funding for supporting the entrepreneurs during the early stages of their companies.

Critical elements for growth include the initial $7.9 million grant from the state and the formation of the partnership. However, Dr. Campbell suggests keeping the organizational structure as simple as possible. He mentioned that their management situation is complicated by the involvement of three 501(c) 3 corporations and a 50/50 partnership.

He stressed the importance of maintaining goodwill in the community, being inclusive in planning and decision-making, developing collaborative rather than

competing relationships and maintaining focus. He also recommended working with an experienced developer during the building planning and construction process.

12.3 Example: Center for Integrated BioSystems

The Center for Integrated BioSystems at Utah State University (USU) is a **university sponsored center** which conducts research and provides analytical services and educational programs serving agriculture and the life sciences. Established on the Utah State University campus in 1991, the center encompasses 30,000 square feet with state-of-the-art equipment for use in fermentation, protein purification, and all aspects of cell culture for use by USU investigators as well as off-campus academic and industrial collaborators. The center's educational programs offer courses in proteomics, fermentation, cell tissue and protein purification with classroom lectures and laboratory exercises.

Interview with Kamal Rashid, Associate Director, Education, October 3, 2007

The center was established as a subdivision of the university in the 1980s by the state legislature as a center of excellence and has been retained as a line item in the state budget. However, state funding covers only the administrative costs of the director, two associate directors and support staff. Their revenue comes from three principal sources:

- Research grants and contracts
- Education and training programs
- Services and the use of core laboratories

The research program is supported largely by grants and contracts from federal agencies that include NIH, NSF, USDA and the Department of Energy (DOE). Projects are in diverse areas of life science that encompass plant, animal, and microbe functional genomics. Dr. Rashid pointed out that agricultural genomics was a significant and expanding area of research for the USDA. They also have project funded by private companies, but they tend to be smaller—in the $30,000 to $40,000 range rather than the million dollar multi-year projects available from federal agencies.

The education and training program encompasses a wide range of programs for high school teachers and students through the Summer Academy and Teacher Symposium programs, seminars for local industrial companies and industrial training programs in biotechnology and bioprocessing. International training is also an important revenue source, and projects have been conducted in Egypt, Korea, Malaysia, Philippines, Puerto Rico, Thailand, Taiwan and Singapore.

The services program provides analytical services and the use of laboratory facilities in genomics, proteomics and bioinformatics. Within those areas, they offer services in

DNA sequencing and analysis, protein synthesis and analysis, and information handling.

Technology transfer activities are conducted through the university's Office of Technology Commercialization.

Critical elements for growth include an initial funding source for staff and facilities, a competitive university research staff and an aggressive marketing program for education, industrial training and research support services.

12.4 Example: Biomedical Research Foundation of Northwest Louisiana

The Biomedical Research Foundation of Northwest Louisiana (BRF) is **an independent, nonprofit, 501(c) (3) organization** established in 1986. The foundation was founded through a recommendation from the Mt. Auburn Study, an economic development report that identified new initiatives to diversify the Shreveport-Bossier economy. Seed funding for the creation of the foundation was provided by the Caddo Parish Commission and the Shreveport Chamber of Commerce. With 51 employees and a volunteer board of directors, the foundation manages a $16 million operating budget and $93 million in assets.

During the past twenty years (1986-2006), the foundation has raised and leveraged the following:

- $213 million with only 10% coming from Caddo Parish tax dollars—a 10:1 return on local public investments.
- $90 million invested in land and buildings to support university research and technology commercialization activities.
- $40 million invested to advance the research mission of LSU Health Sciences Center in Shreveport
- $30 million invested in PET Imaging Center operations. The center currently ranks third behind Memorial Sloan-Kettering Institute in New York City and M.D. Anderson Cancer Center in Houston in number of patients scanned.
- $25 million invested in Intermesh Science Park in programmatic initiatives to create a nationally-recognized regional technology center.
- 20,000 PET patients scanned, with over $10 million in free scans for indigent patients
- 500 construction jobs generated, contributing $17.5 million of wages into the local economy
- 137 InterTech and BRF permanent jobs with an annual payroll of $7 million generated
- Eight educational programs initiated and sustained to build a technology-trained workforce, including:
- CERT - Consortium for Education Research & Technology
- Biotechnology Ph.D. Track

- SMART - Science and Medicine Academic Research Training Program
- MST - Math Science & Technology K-12 Initiative
- EAST - Environmental & Spatial Technology Laboratory
- FIRST Robotics Program - For Inspiration and Recognition of Science & Technology
- Biotechnology Magnet Academy
- Biotechnology Training Program at Bossier High School

Interview with Jack Sharp, President and CEO, October 2, 2007

The idea for BRF was born out of a severe depression in the oil and gas industry in the 1980s that prompted the Chamber of Commerce to conduct an assessment of their regional assets that could be leveraged to diversify their economy. One of those assets was the medical school at Louisiana State University. The foundation was established in 1986 as an economic development organization to build the regional economy based on the biomedical research assets of the university. However, it took six years of negotiation with various organizations before reaching agreement on what should be done. The foundation began operations in 1992, and their first building was completed in 1994. The foundation is an independent, private non-profit organization with a mission to help the university build its research program and provide the facilities to both conduct the research and commercialize it. The university rents space in the foundation's building, which includes wet labs and an imaging center.

The foundation also manages a science and technology park that obtained seed money from an increase in the property tax levied by the county. The 800-acre urban site is being partially reclaimed from oil and gas contamination with federal funding from the Environmental Protection Agency.

Critical elements for growth include consulting support in the early stages of development and patience with the negotiations process. The initial board of the foundation had no experience in such a project and sought help from an experienced consultant to develop their plans. Another critical element was the plan to provide facilities for all stages of the technology commercialization process. This process includes helping the university obtain funding for research with market potential; providing incubator and accelerator space, facilities and advisory support for tenants; and building a research park for stand-alone companies when they reach an adequate stage of maturity.

12.5 Summary of Growth and Viability Elements

Critical elements for growth and viability are illustrated by the four, selected projects described above, which are summarized in the following table.

Center	Type	Critical Elements
Central New York	Early stage of development Partners: a research university, a college and an economic development organization	◆ Initial seed funds from partners for admin costs ◆ $20m grant from state for facility ◆ Write grant proposals while searching for facility site
Bucks County PA	Disease-focused foundation and a local college organized at the county level	◆ Initial $7.9m grant from state ◆ Simple organizational structure ◆ Maintain goodwill in the community ◆ Be inclusive in planning and decision-making ◆ Develop collaborative rather than competing relationships ◆ Maintain focus ◆ Use experienced developer
Utah State University	University-based center offering research, education, training and laboratory services	◆ Initial state funding for admin staff and facilities ◆ A competitive university research staff ◆ An aggressive marketing program for education, industrial training and research support services
Northwest Louisiana	Independent non-profit corporation for economic development	◆ Seed funding from county and chamber of commerce ◆ Consulting support in the early stages of development ◆ Patience with the negotiations process ◆ Provide facilities for all stages of the technology commercialization process from research funding to research park

There is uniform agreement based on the interviews with these four programs:

- Initial seed funding is generally required for a small administrative staff, which is backed up by plans for obtaining funding for a facility.
- Funding sources for bioscience programs typically include the state, county, chambers of commerce and universities.
- All four program examples here are associated with a research institute, university or medical school conducting biotech research.
- All have economic development as part of their missions and have active programs for commercializing their research.
- Most have multiple sources of revenue that include rent from tenants, fees for the use of equipment and education and training programs.

13. Estimate of Economic and Fiscal Impacts

Estimates of the economic and fiscal impacts associated with the operations of the proposed BRDC in Prince George's County have been developed. Impacts are assessed at both the county and state level. Four categories of estimates are provided, including:

- Employment (jobs) impacts
- Wage & Salary (labor income) impacts
- Output (State Gross Domestic Product) impacts
- Tax Revenue impacts

It should be noted that the economic and fiscal impacts presented in this analysis refer to annual, operational impacts of the proposed BRDC once it is fully operational. We understand the term fully operational to mean once all buildings have been constructed/renovated and opened and once an overall occupancy rate of 90 percent has been achieved.[46] This is an important distinction because it means that the analysis does not attempt to incorporate the following elements:

- Any economic and fiscal impacts associated with the construction or renovation of the proposed BRDC.

  The actual work of constructing/renovating a development generates economic impacts in and of itself (albeit these impacts are temporary in nature). Construction/renovation impacts, however, are not part of this analysis.

- Any economic and fiscal impacts associated with the early stages of BRDC development.

  As with most developments, we assume that the BRDC will take some time to become fully operational and that initially, the center will operate at a more limited capacity. For example, if only two of four buildings are constructed and/or renovated and operational for Prince George's Plaza Metro during the initial three years of the BRDC's operations, then annual impacts for those initial years will be lower than the impacts referenced in this analysis.

- Any calculations of new versus existing county impacts.

[46] Typically, full occupancy at bioscience incubators/accelerators is considered to be between 80 and 85 percent. The 15 to 20 percent cushion is often kept available in order to provide room for expansion for tenant firms. It is assumed that the BRDC, which will be comprised of accelerator, rather than incubator space, will have a slightly smaller (10 percent) set aside to accommodate the expansion of tenant firms.

A significant portion of the BRDC tenants may flow from the UMCP (i.e., from the TAP Incubator for instance) or from one of several federal agencies located in the county. Firms that locate in the center could be existing, private sector Prince George's County companies. In each of these instances, employees of the firms that locate to the BRDC are already employed within the county. In other words, in these cases the BRDC is supporting and retaining employment within the county (existing impacts), but not necessarily bringing new employment to the county (new impacts). The same can be said about the spin-off or multiplicative impacts estimated in this report. There is no standard rule of thumb that can be applied to estimate the breakdown of existing and new impacts. The numbers presented in this analysis do not break out "new" from "existing" impacts, but simply present total impacts.

A reasonable breakdown could be: 25 percent existing impacts and the remaining 75 percent of impacts could be new impacts. Based on consultation with the PGCEDC, the office which deals with business prospects for the county, this breakdown is reasonable. Once the BRDC is fully operational, roughly 25 percent of impacts will be existing impacts. Then one can simply discount the total impacts presented in this analysis to isolate "new" from "existing" impacts.[47]

13.1 Impact Analysis Defined

Economists perform economic impact analyses in order to estimate the spillover or multiplicative benefits of a new development. These spillover benefits are commonly defined as indirect and induced impacts and are derived from the direct economic impacts associated with the proposed BRDC.

The centerpiece of an economic impact study is the classification of the impacts. The economic impacts of a given event or circumstances (such as the operations of the BRDC, the construction of a proposed residential facility, a sporting event, etc.) are classified into three general categories: direct impacts, indirect impacts, and induced impacts. In the case of the operations of the BRDC, direct impacts include purchases of goods and services from local merchants by the center as well as purchases by its employees. Indirect impacts measure the positive effects on the economy resulting from businesses selling goods and services to the BRDC employees. Induced impacts include the effects of increased household spending resulting from direct and indirect effects. Put another way, direct impacts are the immediate impacts of the BRDC

[47] When viewing BRDC impacts, the 25 percent of existing impacts should not be discounted. The center is serving an important purpose in this instance. The flow of bioscience firms from Prince George's County (i.e., firms generated within the county at institutions such as UMCP, USDA, etc.) to neighboring jurisdictions such as Montgomery County has already been documented in this study. Although this 25 percent represents existing employment, income and tax revenues for the county, it is essential to retain this employment in order to build the county's bioscience base and the proposed BRDC offers a means to do this.

presence. Indirect and induced impacts are the derivative impacts that flow from the direct impacts.

13.2 Description of Alternative Sites

Three sites are being considered for the proposed BRDC in Prince George's County, so a separate set of economic impact data has been developed for each site. The sites are:

- **Site 1: M-Square**
- **Site 2: Konterra Business Campus**
- **Site 3: Prince George's Plaza Site**

Regardless of which site might be selected, the underlying assumption is that a BRDC would be comprised of accelerator space (space aimed at recent young, maturing companies who have exited an incubator program, but who still need a university tie and mentoring support). However, each site differs in terms of size and scope. The M-Square site is assumed to consist of two, five-story buildings each comprising 105,000 square feet, while the Konterra site is assumed to consist of three buildings with a total of 180,000 square feet. The Prince George's Plaza site is assumed to consist of four, six-story buildings each comprising 120,000 square feet. For a total of 480,000 square feet.

The three sites also differ in terms of configuration of space (i.e., percent breakdown of office and wet lab space). M-Square and Konterra each assume two floors of wet lab space for every three floors of office space, while the Prince George's Plaza Metro site is assumed to have two floors of wet lab space for every four floors of office space.[48]

These differences in size and space configuration drive the differences in estimated economic impacts presented in this analysis.

13.3 Methodology

A modified, input-output (IMPLAN) model has been used to estimate spillover impacts of the proposed BRDC. The IMPLAN model is based on the Bureau of Economic Analysis (BEA) multiplier tables and has been customized for this study to better reflect the economy of Prince George's County.[49] Specifically, the model estimates indirect and induced impacts by applying multipliers to direct impacts.

[48] Based on the incubator/accelerator experience of ANGLE Technology.

[49] See Appendix VI for more detail on the IMPLAN model.

Multipliers are industry-specific factors that estimate the value of a dollar spent in an industry, including not only its direct impacts, but also its indirect and induced impacts. In other words, multipliers estimate the total value of that dollar as it propagates through the economy. For instance, suppose that a dollar is spent in a certain industry. That dollar will increase the number of jobs in that industry by a certain amount. Furthermore, some of that dollar will go to pay the increased earnings in that industry, resulting in higher personal income. In turn, consumers will spend some share of that increase in income. The ultimate impact of the dollar initially spent in a specific certain industry, therefore, is greater than its direct impact on the earnings of that industry. Detailed impact tables appear in Appendix VII.

13.4 Assumptions: Model Inputs

A number of assumptions were inputs to the model.

13.4.1 Estimating Direct Impacts

In addition to incorporating assumptions regarding the size and scope of each proposed site, several additional assumptions regarding the data we input into the IMPLAN model. Specifically, it was necessary to estimate the direct employment and wage and salary impacts associated with each site.

Typically, if a firm plans to open a new branch, the direct impacts will be a known quantity. The firm has a good idea of the number of employees the new branch will employ, as well as the wages and salaries associated with the new positions. Since the proposed BRDC does not fit into this category, both of these factors had to be estimated.

13.4.2 Estimating Direct Employment Impacts for BRDC

To estimate employment associated with a new development, economists rely employment density factors (i.e., the ratio of employment per square footage of space). In other words, an industry standard ratio is applied to the total square footage of the development in order to calculate the estimated number of workers that the development will house. Industry standards are often published by type of space (i.e., for detailed types of retail or office space). In the case of this analysis, each of the three sites incorporates three types of space: wet lab space, office space and retail space.

Because the body of literature on employment density specific to wet lab space is scant, managers of several local incubators were consulted about the average square footage of wet lab space and the average number of employees associated with the typical bioscience incubator tenant in Maryland. These managers are associated with the following incubators: the Maryland Technology Development Center and the Emerging Technology Center. Previously published information from other studies

also was considered.[50] Based on the results of this research, a ratio of 280 square feet of wet lab space per employee is assumed. This assumption is applied to all three sites considered in this analysis. Since the proposed BRDC is expected to comprise accelerator, rather than incubator space, this ratio may be conservative to the extent that the typical accelerator firm has a higher space per employee ratio relative to incubated firms.

Various published studies were consulted to determine an employment density factor for office space. The research on per employee ratios ranged from 150 to 300 square feet of office. This study assumes a ratio of 200 square feet of office space per employee. This assumption is applied to the impact analysis of each site.

Before applying the employment density factors/ratios to the square footage and space configuration for each site, the total square footage had to be discounted to account for nonrentable space. The assumption was made that the net rentable area of the BRDC will comprise 85 percent of the center's total square footage. This percentage, as cited by the National Business Incubation Association, would include space designated for tenant occupancy and use (including common areas).[51]

Applying the estimated space per employee ratios to the adjusted square footage for each site results in the following direct employment estimates:

Site 1: M-Square: 711 employees

Site 2: Konterra Business Campus: 609 employees

Site 3: Prince George's Plaza Metro: 1,662 employees

It should be noted that these estimates refer to employees of tenants who reside in the BRDC space. The estimates do not include personnel/staff associated with the management and operations of the BRDC (i.e., accelerator manager and support staff).

13.4.3 Estimating Direct Wage & Salary Impacts for BRDC

In order to input the above-mentioned direct employment totals into the modified IMPLAN model, it is necessary to first make assumptions regarding the industrial classification of firms likely to locate in the BRDC. Since the focus of the BRDC will be bioscience, using the Governor's Workforce Investment Board's (GWIB's)

[50] The Sage Policy Study, 2005, found that the average incubator tenant requires 1,400 – 1,500 square feet of space. This average was based on information obtained from the following Maryland incubators: the Maryland Technology Development Center, the Silver Spring Innovation Center and the Chesapeake Innovation Center.

[51] Bricks & Mortar Renovating or Building a Business Incubation Facility, p. 26.

definition of bioscience it is assumed that the facility will house a mix of firms that would likely fall in the following industries:

- Testing Labs (NAICS 541380);
- Environmental Consulting Services (NAICS 541620);
- R&D Physical, Engineering, & Life Sciences (NAICS 54171).

Several of the GWIB bioscience industries fall within the manufacturing sector. However, since the focus of the proposed BRDC is not considered to be manufacturing, the GWIB bioscience industry definition has been modified to include only the three above-mentioned (non-manufacturing) industries.

This step of determining the industrial classification of firms likely to locate at BRDC also determines the estimated wage and salary impacts associated with BRDC employment. As previously mentioned, the wages and salaries of employees of the firms that are expected to locate in the proposed center are not a known quantity. However, these wages and salaries can be estimated using IMPLAN, the input/output model which we have calibrated to reflect the economies of Maryland and Prince George's County. Inputting the direct employment totals across the above-listed industries into IMPLAN generates an average annual salary of more than $76,000. In other words, the average annual salary of employees of firm workers likely to locate at the proposed BRDC is estimated to be $76,847. This average figure is consistent across all three sites.

13.5 Assumptions: Model Outputs

When performing an economic impact analysis, the output is typically adjusted to incorporate the following sets of assumptions:

- Assumptions regarding the geographic distribution of impacts;
- Assumptions regarding the local (county) tax revenue impacts outputted by the IMPLAN model.

There are a number of factors that necessitate adjustments to the IMPLAN model output. These factors are explained in this section of the analysis.

13.5.1 Geographic Distribution of Impacts

The first set of assumptions (regarding the geographic distribution of impacts) is critical. The location of the direct employment impacts is a known quantity; it is known that employees of firms that locate at the BRDC will work within Prince George's County. The same cannot be said about the multiplicative (indirect and induced) employment impacts, however.

The IMPLAN model makes no assumption as to where these jobs will be located. For example, firms that locate at the BRDC will require a certain level of goods and services from local businesses, and the purchase of such goods and services will generate/support additional employment in the area (these are known as the indirect impacts). It is likely that BRDC firms will purchase some portion of goods and services from local firms that are situated outside of the county.

To isolate the indirect employment impacts for Prince George's County, it was necessary to make an assumption regarding the extent to which firms (that are providing goods and services to the BRDC's tenants) will be located in the county. To do this, the Quarterly Covered Employment and Wage data published by the Bureau of Labor Statistics were used. Specifically, 2006 employment data were analyzed to determine Prince George's County's level of employment (by industry) as a share of study area employment[52]. Prince George's County's 2006 share of study area employment is shown in the following table.

[52] Technically, the study area considered in this analysis includes two non-Maryland jurisdictions: Washington D.C. and Arlington County, Virginia. For the purpose of this analysis, however, it is assumed that the shares of employment for the Maryland-only jurisdictions that fall within the Study Area. Because of the BRDC's bioscience focus, it is assumed that BRDC firms will be more likely to purchase goods and services from jurisdictions such as Montgomery and Howard County (i.e., jurisdictions with an established bioscience base), rather than crossing the Potomac.

Share of Study Area Employment

Sector	Prince George's County's Percent Share
Agriculture, Forestry, Fish & Hunting	7.9
Mining	26.2
Utilities	36.4
Construction	24.7
Manufacturing	13.7
Wholesale Trade	18.8
Transportation & Warehousing	27.4
Retail Trade	19.6
Information	19.9
Finance & insurance	10.8
Real Estate & Rental	16.7
Professional- Scientific & Tech Services	13.3
Management of Companies	19.3
Administrative & Waste Services	18.4
Educational Services	10.8
Health & Social Services	14.6
Arts- Entertainment & Recreation	17.1
Accommodation & food services	17.6
Other Services	16.8
Government	28.9
Institutions	0.0
Total	***19.4***

These shares were applied to the IMPLAN indirect and induced impacts in order to isolate Prince George's County's share of these spin-off impacts. It is assumed that the remaining spin-off impacts (roughly 80 percent) will be distributed across the balance of Maryland.

13.5.2 Local (County) Tax Revenue Impacts

One limitation of the IMPLAN model is that it does not calculate local tax revenue impacts. State and federal impacts are outputted, but to determine the Prince George's County tax revenue impacts attributable to the proposed BRDC, an estimate was produced using the following steps:

1. Using commuting patterns data published by the U.S. Census Bureau, the number of Prince George's County employees (resulting from Center operations) that are likely to live in Prince George's County was estimated. Another estimation was made about the number of additional (non-Prince George's County), Maryland employees (resulting from BRDC operations) that are likely to live in Prince George's County. The sum of these two factors provides an estimate of the number of new households that are added to the county's tax base as a result of BRDC operations.

2. Using the average salary information outputted by IMPLAN, average annual household income associated with this new tax base was estimated. This household income was further adjusted to reflect the portion of households that are likely to be dual-income households.[53]

3. To estimate annual county property tax revenues, the average household income was used to estimate the average home price that these new households would be able to afford. Then a blended average real property tax rate (incorporating both municipal and county rates) was applied to the average home price.

   Recognizing that not all new households will be homeowners, the number of new households by the county's homeownership rate was discounted.

   It should be noted that county property tax revenue estimates provided in this analysis include only the portion of property tax income associated with new home sales. The operations of the proposed BRDC will result in new residents moving to the county. These new residents will generate additional tax revenues for the county. To the extent that these residents move into existing homes and replace existing residents, however, this revenue does not necessarily represent new revenue for the county. For this reason, the portion of new residents likely to move into new Prince George's County homes was isolated. To isolate this portion, the ratio of new to existing home sales for the year 2006 was used. These data are provided by the U.S. Census Bureau and the National Association of Realtors for U.S. regions. A weighted average of

[53] Specifically, the portion of these households likely to be married with both spouses working (using U.S. Census Bureau estimates) was estimated and it was assumed that the additional household income source would be equal to Prince George's County's per capita income. Then a weighted household income figure was calculated.

this ratio for the North and Southeast regions was taken.[54] This ratio was then applied to the number of households estimated in Step 1.

Moreover, the property tax revenues presented in this analysis do not include any revenue generation attributable to the BRDC property, itself. According to the State Department of Assessment & Taxation (SDAT), the three properties considered in this analysis are associated with the following 2007 assessed values (including land and improvements):

- M-Square: $2.4 million;
- Konterra Business Campus: $1.3 million
- Prince George's Plaza Metro: $3.0 million

Since as of the writing of this analysis, it is not known whether the county will elect to own or lease the BRDC property, any estimate of property tax revenue generation attributable to the BRDC property was not included.

4. To estimate annual county income tax revenues, the local income tax rate was applied to the weighted household income and the estimated number of householders expected to generate income (as estimated in Steps 1 and 2).[55]

13.6 Economic and Fiscal Impacts

13.6.1 Maryland

It is estimated that the proposed BRDC will generate/support between 1,125 and 3,073 jobs for Maryland's economy.[56] This range reflects the difference in the scope and size of each of the three sites. The Konterra Business Campus site, for instance, is expected to generate a lower level of job creation (1,125) relative to the M-Square and Prince George's Plaza Metro sites. This is not surprising considering that the square footage of BRDC space associated with the Konterra site represents roughly 86 percent of the square footage associated with the M-Square site and roughly 38 percent of the square footage associated with the Prince George's Plaza Metro site. The annual direct jobs impacts (the jobs to be located in the proposed BRDC) range from 609 to 1,662.

[54] Existing home sales data are provided at the county level by the Maryland Association of Realtors, however county-specific new home sales data are not available. For this reason, U.S. regional data were used.

[55] Before applying the county income tax rate, the average annual household income was discounted by 17 percent to account for standard income deductions. This 17 percent figure was verified by several local finance offices.

[56] All impacts referenced in this analysis refer to impacts generated by the operations of the BRDC once it is fully operational (i.e., once all buildings are constructed/renovated and open and the center has achieved an overall occupancy rate of 90 percent).

Annual Economic Impacts for Maryland[57]
Dollar Figures in Millions of 2006 Dollars

Maryland - Employment Impacts					
Site	Name	Direct	Indirect	Induced	Total
1	M-Square	711	276	328	1,315
2	Konterra Business Campus	609	236	280	1,125
3	Prince George's Plaza Metro	1,662	646	765	3,073
Maryland - Wage & Salary (Income) Impacts					
Site	Name	Direct	Indirect	Induced	Total
1	M-Square	$54.6	$12.4	$11.7	$78.7
2	Konterra Business Campus	$46.8	$10.6	$10.0	$67.4
3	Prince George's Plaza Metro	$127.7	$29.0	$27.3	$184.0
Maryland - Output Impacts					
Site	Name	Direct	Indirect	Induced	Total
1	M-Square	$106.9	$32.2	$36.3	$175.4
2	Konterra Business Campus	$91.6	$27.6	$31.1	$150.3
3	Prince George's Plaza Metro	$250.0	$75.2	$84.8	$410.0

Additionally, it is estimated that the annual income associated with these jobs will range from $67.4 to $184.0 million. This translates into overall average annual salary of just under $60,000 (for all three scenarios). Average wages and salaries for the direct jobs amount to $76,847.

Operations of the proposed BRDC will also generate output (Gross Domestic Product) for the State of Maryland. Gross Domestic Product (GDP) refers to the total market value of the goods and services produced in a given region over a given period of time. It is estimated that operations of the proposed BRDC will add between $150.3 million and $410 million to the state's annual output level.

13.6.2 Prince George's County

It is estimated that the proposed BRDC will generate/support between 699 and 1,907 jobs for Prince George's County's economy.[58] As previously mentioned, this range

[57] Numbers may not add up due to rounding.

[58] The location of the direct employment created by the BRDC is a known quantity (it is known that employees of firms that locate to the center will work within Prince George's County). However, the same cannot be said of the multiplicative (indirect and induced) employment impacts that these direct jobs will create/support. The IMPLAN model makes no assumption as to where the multiplicative jobs will be located. It is likely that BRDC firms will purchase some portion of goods and services from local firms that are situated outside of the County. To isolate the portion of multiplicative economic impacts that will occur in Prince George's County, it was necessary to make certain assumptions. These assumptions are discussed in detail in section 13.5 of this report.

reflects the difference in the scope and size of each of the three scenarios. The annual direct jobs impacts (the jobs to be located in the proposed BRDC) range from 609 to 1,662.

Annual Economic Impacts for Prince George's County
Dollar Figures in Millions of 2006 Dollars

Prince George's County - Employment Impacts					
Site	Name	Direct	Indirect	Induced	Total
1	M-Square	711	49	56	816
2	Konterra Business Campus	609	42	48	699
3	Prince George's Plaza Metro	1,662	114	131	1,907
Prince George's County - Wage & Salary (Income) Impacts					
Site	Site	Direct	Indirect	Induced	Total
1	M-Square	$54.6	$2.1	$2.0	$58.7
2	Konterra Business Campus	$46.8	$1.8	$1.7	$50.3
3	Prince George's Plaza Metro	$127.7	$5.0	$4.7	$137.4
Prince George's County - Output Impacts					
Site	Site	Direct	Indirect	Induced	Total
1	M-Square	$107.2	$6.2	$7.0	$120.4
2	Konterra Business Campus	$91.6	$4.8	$6.1	$102.5
3	Prince George's Plaza Metro	$250.0	$13.0	$16.6	$279.6

It is also estimated that the annual income associated with these jobs will range from $50.3 to $137.4 million. This translates into an overall average annual salary of roughly $72,000 (for all three sites).[59] Average wages and salaries for the direct jobs amount to $76,847. Operations of the proposed BRDC will also generate output (GDP) for Prince George's County's economy. Annual output estimates range from $102.5 million to $279.6 million.

13.6.3 Summary of State & Local Fiscal Impacts

It is estimated that the proposed BRDC will generate between $8.7 and $24.0 million in annual state and local tax revenues. Annual property tax revenues expected to accrue to the county range from $0.3 to $0.7 million per year, while the county is expected to receive between $1.3 and $3.6 million in income taxes due to BRDC operations.

[59] Average annual salaries are higher for Prince George's County relative to Maryland, because the Prince George's County has less indirect and induced jobs and income impacts, thus results are heavily driven by the average annual salaries for direct employees, which is quite high at $76,000.

As previously noted, the county property tax revenue figures presented in this analysis include only the portion of property tax income associated with new home sales. The operations of the BRDC will result in new residents moving to the county. These new residents will generate additional tax revenues for the county. To the extent that these residents move into existing homes and replace existing residents, however, this revenue does not necessarily represent new revenue for the county. For this reason, the portion of new residents likely to move into new Prince George's County homes was isolated.

Annual State and Local Fiscal Impacts[60]
Dollar Figures in Millions of 2006 Dollars

Revenue Category	M-Square	Konterra Business Campus	Prince George's Plaza Metro
Corporate Profits Tax	$0.3	$0.2	$0.7
Dividends	$0.4	$0.3	$0.9
Indirect Bus Tax: Motor Vehicle License	$0.1	$0.0	$0.1
Indirect Bus Tax: Other Taxes	$0.6	$0.5	$1.4
Indirect Bus Tax: State Property Tax	$1.7	$1.5	$4.1
Indirect Bus Tax: County Property Tax	$0.3	$0.3	$0.7
Indirect Bus Tax: S/L NonTaxes	$0.2	$0.1	$0.3
Indirect Bus Tax: Sales Tax	$1.2	$1.0	$2.8
Personal Tax: State Income Tax	$3.3	$2.9	$7.8
Personal Tax: County Income Tax	***$1.6***	***$1.3***	***$3.6***
Personal Tax: Motor Vehicle License	$0.1	$0.1	$0.2
Personal Tax: NonTaxes (Fines- Fees)	$0.4	$0.4	$1.0
Personal Tax: Other Tax (Fish/Hunt)	$0.0	$0.0	$0.0
Personal Tax: Property Taxes	$0.0	$0.0	$0.1
Social Ins Tax- Employee Contribution	$0.0	$0.0	$0.1
Social Ins Tax- Employer Contribution	$0.1	$0.1	$0.2
Total State & County Tax Revenues	**$10.3**	**$8.7**	**$24.0**

13.7 Net Fiscal Impact

In addition to estimating annual economic impacts associated with operations of the BRDC, this analysis also estimates the net fiscal impacts of the proposed BRDC at the county level. In other words, not only does the analysis estimate the number of jobs the BRDC will create/support within the county, but also the budget implications (i.e., additional public facility requirements and costs) associated with the new employees and residents that will be attracted to the county as a result of the proposed project. For the purpose of this analysis, the net fiscal impact refers to the difference between annual tax revenue generation and annual cost of services.

[60] Numbers may not add up due to rounding.

13.7.1 Results

A new development brings not only many benefits (i.e., the generation of new jobs and labor income for a given area), but also costs, as well. For example, when the development and operations of a facility attracts new employees and residents to an area, demand for public services such as education, water/sewer, roadway maintenance and improvement, etc. will increase. These additional public facility requirements are referred as the "cost of services" associated with a given project. By comparing the economic and fiscal impacts to the cost of services, one can get an idea of the likely net fiscal impact associated with the proposed BRDC.[61]

Annual Net Fiscal Impact[62]
Dollar Figures in Millions of 2006 Dollars

Prince George's County – Net Fiscal Impact (Once BRDC is Fully Operational)				
Site	Name	Annual County Tax Revenues	Annual County Cost of Services	Net Fiscal Impact
1	M-Square	$1.9	$1.0	$0.9
2	Konterra Business Campus	$1.6	$0.9	$0.7
3	Prince George's Plaza Metro	$4.3	$2.4	$1.9

Findings indicate that Prince George's County stands to gain net economic benefits from the proposed BRDC. Results suggest that, once the BRDC is fully operational, the increased local government financial obligations associated with the proposed development will be partially offset by annual tax revenues generated. This is true for each site.

13.7.2 Assumptions

To estimate the annual cost of services attributable to the operations of the BRDC, the current service expenditures that the county makes on per resident and per employee basis were calculated.[63] These costs were then applied to the estimated number of residents and employees estimated to be generated and/or supported by the BRDC.

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[61] Cost of Services calculations only refer to operational costs associated with new residents and employees; calculations do not capture any capital expenditures that may be needed (a new school or police substation).

[62] Numbers may not add up due to rounding.

[63] To perform this step, figures published by the Department of Legislative Services (Local Government Finances in Maryland) were used.

The resulting cost of services is then discounted to isolate costs attributable to residents moving into new Prince George's County homes. In other words, the costs attributable to residents moving into existing homes were excluded.[64] The logic behind this assumption is that residents moving into existing homes will replace existing residents, and therefore do not necessarily increase the county's cost of services level.

Moreover, as noted above, not all of the employees supported by BRDC will be new residents/employees to the county. Some portion will be comprised of existing Prince George's County residents/employees. Thus, both the tax revenue and cost of services figures reported in this analysis include a portion of revenues/costs that the county is already receiving and/or bearing.

[64] To isolate cost of services attributable to residents moving into new homes, cost of services estimates were discounted by the ratio of new to existing home sales.

14. Implementation Strategy

Based on the feasibility study work, a three-phase approach could be used to attract and develop increased levels of life science research and development activity in Prince George's County, and to create the physical infrastructure to sustain these types of activity.

14.1 Three-Phase Approach

Immediate Steps: PGCEDC should work with real estate brokers of wet lab space in the county, such as Alexandria Real Estate, over the next six months to try and develop a system for accommodating life science company needs with existing, but underutilized wet lab space in the county. This could help TAP incubator graduates and possibly attract new companies with requirements for small amounts of wet lab space. This is an important step because it reinforces the county's interest in life science business attraction and growth. Even modest success at this initial stage can facilitate subsequent progress.

Near Term Steps: PGCEDC, together with state, academic, industry and non-profit partners should initiate planning for a Biotechnology Research and Development Center in the county within the next 12 months. An implementation plan for this near term option is outlined in the following sections.

Longer Term Steps: PGCEDC, together with state, academic, industry and nonprofit partners should look ahead in the next 24-36 months to further consider the establishment of a large scale technology park in the county. The approximately 250-acre site consisting of adjacent properties owned by the University of the District of Columbia and Howard University on Muirkirk Road (see Section -8.3, Site 7) could be a good location for this type of development. While not located close to UMCP, which is approximately seven miles from this site, it is located near a growing group of the county's biotechnology companies. Howard University has considered this site for a North Campus development. It has very good road access and ample expansion opportunities on more than 250 acres. Moreover, a Prince George's County development in this location off of US1 and near the Intercounty Connector interchange on I-95, could anchor the growing "innovation corridor" that already stretches from Hyattsville, northwards beyond USDA-BARC. A development in this location could position Prince George's County to benefit from easier, more extensive connections west to Montgomery County companies and workforce via the Intercounty Connector.

14.2 BRDC Development Approach

In the near term, the development of a single flagship facility with wet lab space targeted to early-stage and incubator graduate companies is recommended to help the

county capture an increased share of the region's expanding life science and biomedical activity. There are several approaches that the county can take.

- The county may undertake this development activity itself, assume all the risk and have substantial control of the project by serving as its own developer and project manager.

- The county can work in conjunction with university, public sector (such as the Maryland Economic Development Corporation) or commercial real estate development partners. The county's risk exposure would be less using this approach, but the county would have less control over the project. If the county opts to partner with a commercial developer for this project, there are numerous experienced developers creating facilities with wet lab space in the Washington-Baltimore area who would be suitable partners for the county.

- The county can convey the land to a developer or other partner and have a limited development role, which minimizes the county's risk, but can limit the county's ability to influence the development of the project.

Regardless of the development approach selected, the PGCEDC should play a central role in helping assemble the funding package for the project, monitoring the land acquisition issues and monitoring the overall development of the BRDC through a working implementation committee.

Longer term, the county should explore the development of a larger, technology park development for the life science industry. The two adjacent sites on Muirkirk Road totaling more than 250 acres and owned by the University of the District of Columbia and Howard University would be a potential site for a technology park in the county. Two examples of this type of development in Montgomery County are the 200-acre Shady Grove Life Sciences Center which was launched in the 1980s in western Montgomery County and the 115-acre East County Science and Technology Center adjacent to the new FDA headquarters in White Oak which is under development now by Montgomery County. This new center would have 800,000 square feet of space in a dozen buildings and it has been presented by Montgomery County as a bioscience park with a mix of functions, including an incubator.

Prince George's County would have the same implementation options described above, but given the scope of this type of project, having university or real estate development partners may be preferable.

14.3 Project Development and Management Process

This feasibility study has generated key information and identified special resources which have been incorporated into the implementation strategy for the BRDC. The implementation strategy will require a range of partnerships. The final sections of the report detail best practice public/private partnering approaches, as well as potential

partners and developers for the project. Funding sources and incentives specifically tailored to Prince George's County are outlined and two general flow charts for project and program development are included.

Implementation of the type of initiative proposed in this report requires a number of different elements to be addressed in order to have a good chance of success. Many of these elements relate to the organizational, networking and project management aspects of the work, as much as to the process of undertaking the physical development of a given site or sites. The process of developing a site once the necessary land has been acquired or made available is a well-established one. Providing that the site has no unusual challenges such as environmental contamination, the management of the process is relatively straightforward. If the organization leading the project does not have the necessary skills and experience in-house, the management of the site development and construction process can be contracted out.

The management of the other aspects of such a project can however be more challenging. It may require the coordination of a potentially large number of participating organizations, each with its own requirements.

The necessary steps required for this management process to be effective are as follows:

- Obtaining support within the originating organization
- Obtaining the support of other organizations that are necessary participants
- Building a governance structure for the project
- Obtaining agreement from all participants on the implementation plan
- Selecting a developer (this may be one of the organizations already participating in the project)
- Agreeing to a contract with the developer
- Ongoing monitoring and review

The management of these steps is also a discrete task in itself, which may be handled directly by the originating organization, or again, contracted out. In either case, it must be borne in mind that any such committee or group will require an executive function in order to be able to conduct its business, and that a committee without such executive support is unlikely to achieve any meaningful results.

Each of the tasks outlined above is discussed in more detail in the following sections, and a BRDC project plan outline is provided in Appendix X to illustrate possible

timing of various components of the process. The final project plan will clearly be something to be agreed in detail within the agreed governance structure.

14.4 Obtaining Support within the Originating Organizations

In most projects of this kind, there is an organization that has acted to initiate and sponsor the process of investigating the possibility of creating a new initiative, and in the present case, this has been the Prince George's County Council. During the study process for the BRDC, representatives from several other organizations, such as M-NCPPC Prince George's County Planning Department, PGCEDC, and the University of Maryland have been engaged in the discussions about the proposed initiative and served on the committee for the study. This has begun a process of engagement in which their priorities have been identified, and the extent to which these can be mapped onto, and incorporated within the initiative will have been explored. This is a valuable part of the process of developing the initiative, but it is important to ensure that no binding commitments are made until such time as the key individuals and groups within the originating organization have had an opportunity to review, and lend their support to, the proposal. Each organization has its own internal protocols for managing the process of obtaining such support, and it is necessary to ensure that these are followed.

In the present case, there are four groups with whom it is appropriate to initially discuss the study and the implementation of the proposed initiative. Formal briefings on the study by the ANGLE Project Team were scheduled with these groups:

- The Prince George's County Planning Department staff
- Prince George's County Planning Board
- Prince George's County Council
- Prince George's County Office of the County Executive

As part of the process of gaining the support of these groups, the proposed initiative should be presented indicating the participation of many of the organizations needed to enable the project to move forward. The support of the group to engage with these other organizations in order to involve them in the proposed initiative should be sought. This will provide a platform for the establishment of the necessary cross-organizational governance structure and process that will oversee the implementation of the initiative, and ensure co-ordination of the involvement of each necessary participant.

As a part of the process, it will also be necessary to agree which individual(s) within these organizations will have responsibility for managing the process going forward. It also will be necessary to determine whether any elements of the management process will be contracted out, so that those whose approval is being sought are

presented with a complete picture of what is intended. Development projects, such as the proposed BRDC are typically overseen by county-level economic development organizations, such as PGCEDC, working in partnership with county government, universities and the private sector. The involvement of the local economic development organization brings a practical knowledge and a relevant technical skill set to the project. This involvement also brings continuity and an established network of industry, governmental and community contacts. Continuity is especially important for long-term development projects such as this one, which could span the administrations of multiple county executives. It is recommended that the PCGEDC provides the central leadership for the implementation of this proposed project.

14.5 Obtaining the Support of Other Organizations

Having completed the process of obtaining the necessary support within the study committee organizations, the organization / individual who it has been agreed will act as project manager will then need to engage with the other relevant organizations. As noted earlier, the foundations for this will have been laid during the earlier work on the development of the initiative, and many of the necessary organizations will already be aware of the proposed project. There may nonetheless be a need to brief other organizations about the proposed initiative, and gain their support and involvement.

It is generally the case that initiatives of this kind are perceived within the business community as being more credible if there is involvement from the private sector. This has the potential advantage not only of demonstrating private sector interest, but it can also provide a valuable source of knowledge and guidance from the industry at which the initiative is targeted. Potential private sector participants can be identified through industry groups and existing networks within the economic development community. The PGCEDC is well positioned to handle this type of outreach.

14.6 Building a Governance Structure for the Project

An important part of the development process is to offer the opportunity for representatives of relevant organizations to participate in the governance structure. This governance structure generally takes the form of a project implementation committee; although in some circumstances it may be constituted as a board in its own right. This is more often the case when a new organization is to be created as the vehicle for the implementation of the project.

An important consideration is selecting the chairman of this committee. Generally an individual from the originating organization (the county in this case) takes this role. There can be value however in considering the possibility of involving someone from the private sector in this role. Doing so reinforces the need to focus on plans that are truly relevant to the target group and broadens the ownership of the initiative beyond the economic development community. It is normally the case that the chairman is

identified early in the process of putting the governance structure in place. This way the chairman can be involved in the process of selecting other committee members.

14.7 Obtaining Agreement on the Implementation Plan

Once the governance structure is in place, it is generally necessary to revisit the proposed implementation plan and ensure that all participants are broadly in agreement on the way forward. During this process it is important to ensure that minor differences of opinion do not become significant obstacles to moving forward and that the focus on the project as a whole is maintained. The chairman can and should play an important role in this process.

Once agreement has been reached, it may be necessary for some of the participants to obtain formal approval from their own organizations for support of the project. This is generally the case if the organization is being required to commit resources to the initiative beyond participation in the implementation committee.

A critical component of the implementation plan will be agreement on:

- The site to be utilized for the first phase of the initiative
- The development approach to be taken

The selection of the site for the first phase of the project may have already taken place by this stage, particularly if the site is under the direct control of one of the partners, such as the county. If not, it will be necessary for the implementation committee to undertake the site selection process. This in itself is likely to involve further analysis and may also involved additional approval processes from one or more of the partners in the project. These steps may delay the implementation of the project but they are essential to ensuring ultimate success.

14.8 Selecting a developer

The development approach to be taken may be influenced by the site selection process, particularly if the selected site is under the direct control of one of the partners in the project. It may be that one of the participating organizations, such as the county or The University of Maryland is willing and able to take on the role of developer directly (or has access to resources that can do so). In this instance, provided all parties agree, it should be possible to proceed with the project directly, with this partner undertaking the management of the site planning and construction process.

In the event a private developer will be sought, it is advantageous to implement a competitive bidding process for the development of the site. By doing so, it is possible to identify the developer that is best equipped not only to finance the project, but also to most closely meet the economic development objectives of the initiative.

This may include the developer making a contribution to the initiative in return for access to the site, with respect to aspects such as building design, leasing terms, building density, etc. that are beneficial to the project. This would not necessarily be part of a project that was purely an initiative of the private sector. It is also possible with such a competition to explore a variety of architectural and design approaches in a way that may not be possible with a single developer.

The organization of such a competition is relatively straightforward, although time consuming. It requires the preparation of detailed Request for Proposal (RFP) documents, a structured process for receipt and evaluation of responses, selection of a preferred bidder, and subsequent negotiation on the detailed terms of a development agreement. The process may also include a preliminary step of issuing a Request for Expressions of Interest (RFI) prior to issuing a formal RFP. This can provide an opportunity to identify a wider field of potential developers than may be achieved by directly going to an RFP.

14.9 Agreeing to a Contract

The county process for developing the contact and for the administrative and legal review of the contract should be followed. The process of contract negotiation and review should be handled expeditiously.

14.10 Ongoing monitoring and review

Once the developer is selected, the role of the implementation committee is then to review final design and detailed development proposals from the selected developer and then to monitor the development process. Whether the longevity of the development committee is to extend beyond the completion of the physical construction of the facilities on the selected site will be something for the partners in the committee to discuss and agree among themselves. It is probable that if the recommendations of this report are followed in full, and a plan is adopted for a site, it would make sense for the committee to remain in place to oversee the initiative in the longer term. If this is not the case, the committee may be disbanded once the initial development is complete, with ongoing oversight taking place through existing mechanisms within the partner organizations, such as the PGCEDC.

15. Best Practice Public/Private Partnership Models

There are many different approaches to developing the governance or partnership models which could be utilized for the creation of a biotechnology research and development center in Prince George's County. As noted in this report, BRDC is defined as a single facility, rather than a research park, for the purposes of this project. Representative public/private partnership models for developing a biotechnology development center in communities outside Maryland, such as Buck's County, PA, Central New York State, Utah State and Northwest Louisiana have been researched and summarized in the below table.

These models highlight important elements for Prince George's County that have driven successful biotechnology research and development centers. The critical elements in all of these projects include state funding, strong university engagement and research partnerships, and the provision of appropriate facilities. In addition, the Bucks County example underscored the importance of including an experienced commercial developer partner.

Partnership Models

Center	Type	Critical Elements	Strengths & Weaknesses
Central New York Biotechnology Research Center	A partnership between a research university, a college and an economic development organization	◆ Initial seed funds from partners for admin costs ◆ $20m grant from state for facility ◆ Write grant proposals while searching for facility site	◆ Associated with a well established research center (S) ◆ Inadequate seed funding (W)
Pennsylvania Biotechnology Center of Bucks County	Disease-focused foundation and a local college organized at the county level	◆ Initial $7.9m grant from state ◆ Simple org structure ◆ maintain goodwill in the community ◆ be inclusive in planning and decision-making ◆ develop collaborative rather than competing relationships ◆ maintain focus ◆ Use experienced developer	◆ State funding (S) ◆ Complex management situation (W)
Center for Integrated BioSystems, Utah State University	University-based center offering research, education, training and laboratory services	◆ Initial state funding for admin staff and facilities ◆ A competitive university research staff ◆ An aggressive marketing program for education, industrial training and research support services	◆ Annual funding from the state as a subdivision of the university (S) ◆ Multiple revenue sources (S) ◆ University management (W)
BioMedical Research Foundation of Northwest Louisiana	Independent non-profit corporation for economic development	◆ Seed funding from County and Chamber ◆ Consulting support in the early stages of development ◆ Patience with the negotiations process ◆ Provide facilities for all stages of the technology commercialization process from research funding to research park	◆ Addresses all elements of the TBED[65] process (S) ◆ Lengthy start up time (6 years) (W)

[65] Technology- based economic development (TBED) is a term used by the economic development community.

16. Partner Identification

Several prospective public/private and nonprofit sponsors, partners and prospective tenants for the Center have been identified through the research and interview program of this study.

16.1 Potential Partners

Maryland Department of Business and Economic Development

The state of Maryland's focus on bioscience company development can support the county's own bioscience development activity. In June 2008, Maryland Governor Martin O'Malley announced the launch of his Bio 2020 Initiative which will invest $1.1 billion in the state's bioscience industry over the next decade, expanding tax credits, bolstering stem cell research and providing new support for start-up life science companies. The Governor's initiative can be expected to leverage an additional $6.3 billion in private and federal investments that will help generate thousands of new jobs by in Maryland by 2020. Under the Governor's plan, the state would double its biotech investment tax credit next year and double it again within the next five years, leading to an increase of $24 million. Maryland also would invest at least $20 million each year into stem cell research, to become one of the three largest stem cell funds in the nation. The Governor is interested in helping companies establish themselves and will invest $60 million and increase the availability of incubator space for start-ups by 50 percent. The state is also expected to invest $300 million into bioscience facilities in Maryland and strengthen the Maryland Technology Transfer Fund, which helps spin out start-ups from university research, with a $107 million investment. The Governor also promised to augment the Maryland Venture Fund, which provides grants to start-ups and makes equity investments in established companies, increasing public investment by $152 million.

Maryland Economic Development Corporation

A valuable funding and operational partner for Prince George's County, which is listed with the other funding contacts is the Maryland Economic Development Corporation (MEDCO). MEDCO is a private corporation established in 1984 by the State of Maryland to assist in the expansion, modernization and retention of existing Maryland businesses and to attract new businesses to the state. Businesses seeking to expand or relocate into Maryland regularly turn to MEDCO as a resource. MEDCO also assists, upon request, local jurisdiction projects. MEDCO owns and administers all of the incubators in Montgomery County. MEDCO has never assisted PGCEDC with a project and has expressed interest in working with the county on the development of a BRDC.

MedStar Research Institute

MedStar Research Institute conducts clinical trials that involve patient populations in Prince George's County. With administrative offices in Hyattsville, the Institute has several locations in the county, including a small laboratory near Prince George's Plaza Metro. Metro access is important for MedStar clinical trials participants. Neil Weissman, MD, Executive Director of MedStar has expressed interest in consolidating his operations in a single location where he can increase his staff and construct additional laboratory facilities. MedStar would consider being an anchor tenant in a biotechnology research and development center located near the Prince George's Plaza and College Park Metro stations.

Fischell Department of Bioengineering, University of Maryland

The Fischell Department of Bioengineering at the UMCP A. James Clark School of Engineering could be a key partner for this project, but should not be considered the only University of Maryland partner for this project. The Department of Bioengineering has grown rapidly in the two years since it moved into the new Yeong Kim Engineering Building on the College Park campus. According to the Chair of the Bioengineering program, William Bentley, Ph. D., expansion options, including construction of a new building by the program's benefactor, Robert Fischell are currently being discussed in a general way. The ideal locations targeted in these early discussions would be as close as possible to the College Park campus or north of the University, near Konterra, to be closer to the Johns Hopkins University's Advanced Physics Lab and Baltimore.

Biotechnical Institute of Maryland, Inc.

The Biotechnical Institute of Maryland (BTI) is a Baltimore-based nonprofit organization established to fill a need for specialty scientific training of entry-level biotechnicians for employment in Maryland's rapidly expanding biotechnology industry. The BTI Laboratory Associates program provides tuition-free training in basic laboratory skills to bright, ambitious and unemployed or under–employed Maryland residents. Many local companies employ BTI graduates. BTI is interested in expanding its program from Baltimore to other Maryland locations and Prince George's County is a top choice for the expansion. Metro access would be a key factor in BTI's location decision.

Medix South

Medix South, with several locations across the country, recently opened a for profit training program in Landover, MD which prepares students for a range of entry level positions in biotech and pharmaceutical labs, manufacturing labs or crime labs. The 11-month Medix South Biotechnician Program prepares students for entry-level, research, manufacturing, and quality control positions in academic and industrial biotechnology facilities. Students can learn standard lab operating procedures, bio-

manufacturing, recombinant protein production and DNA/fingerprinting techniques for positions such as lab technicians, research assistants, microbiology technicians, and chemical analysts. Students intern with research and development organizations in the region during their training. Medix South currently has two teaching laboratories in Landover and they could be a potential tenant and workforce development partner for the county at BRDC.

Bowie State University

With 18 departments, 25 undergraduate majors, 19 master's degree programs, two doctoral programs, and nine advanced certificate programs, Bowie State University offers a wide range of academic resources to support the development of a Biotechnology Research and Development Center in the county. The National Science Foundation has recognized the strength of the University's science, engineering, and mathematics programs by selecting it as one of six Historically Black Colleges/Universities to be chosen as a Model Institution of Excellence. Research at the University is supported by such advanced facilities as a $1 million supercomputer and a NASA satellite operations control center.

Howard University

The Strategic Plan for Howard University calls for the development of a 200-acre North Campus site in Beltsville that the University owns adjacent to a site owned by the University of the District of Columbia. This Howard University site is currently being studied for possible development, but before proceeding further it will require input and approval from the University administration. Howard University is still in a transition period, having named Sidney A. Ribeau, Ph.D. as its new president. The Howard University real estate office has expressed interest in discussing the development of North Campus with Prince George's County. Howard University, with its Medical School, intensive doctoral/research focus and historic interest in Prince George's County as an expansion location, could be an important partner with the county in near-term projects, such as the BRDC, where the University may want to lease space. Longer-term, the University and the county may share development interests in the North Campus site.

University of the District of Columbia

The University of the District of Columbia (UDC) also is in transition, having named Allen Sessoms Ph.D. as its new president. This new leadership presents an opportunity for discussion between Prince George's County and UDC regarding a UDC presence in the county. Moreover, in May 2008, the passage of the 2008 farm bill provided access to $3 million in additional funding for the University of the District of Columbia's Agricultural Experiment Station (AES) and Cooperative Extension Service (CES). Such provisions will ensure access to nutrition education assistance for more than 315,000 District of Columbia residents, historically omitted from essential nutrition education programs administered by the USDA.

AES is responsible for finding solutions to urban problems through research, investigations and experiments. CES is a city-wide informal education system which positively impacts the city by providing key programs that educate, inform and engage District of Columbia residents. The two land-grant units, AES and CES, work together to extend beneficial research findings to individuals and local communities. This additional funding for agriculture-related research in the farm bill may increase UDC's interest in working with Prince George's County and accessing resources in the county, such as the USDA-BARC.

16.2 Potential Developers

There are many developers working in this region and working nationally who would be interested in working with Prince George's County on a project such as this, which makes financial sense. The challenge for the county would be to select the developer partner with the best match of experience, market understanding and financing approach. County economic development officials have indicated that they are interested in considering a developer partnership to deliver this project. Given the concentration of life science research activity in Maryland, there are many developers with relevant experience and current projects in the region. A very short list of these developers includes:

Alexandria Real Estate Equities, Inc.

Alexandria Real Estate Equities (ARE) is a national firm which focuses on life science projects and offers construction and facility management services. ARE is the owner and leasing agent for several wet lab and office properties in the region, including Prince George's County. The ARE space in Prince George's County includes manufacturing space and is currently leased by Baxter, but appears under-utilized. This could present an opportunity for the county to work with ARE to make that space available to biotech companies interested in a county location.

In January 2008 ARE announced that it was turning 15,000 square feet of unused wet lab space in Montgomery County that it owned into that county's newest incubator-type facility. ARE launched the incubator with a tenant occupying 2,000 square feet. ARE is targeting a similar company profile for its "incubator" as the county is for the BRDC—maturing biotech companies that require real estate, priced in the high $20s per square foot, with access to some business mentoring and support, rather than early-stage companies seeking extensive incubation services. ARE's Mid-Atlantic Senior Vice President, Lawrence Diamond, is a member of the Maryland Governor's Life Sciences Advisory Board which oversees the BioMaryland 2020 initiative.

Wexford Science + Technology

Wexford is a wholly owned subsidiary of Wexford Equities, LLC). Wexford Science+Technology is a privately held real estate investment and development company based in Baltimore, Maryland. Wexford is an experienced development

partner on projects such as the proposed Biotechnology Research and Development Center. Wexford is currently developing Building One in the BioPark development at the University of Maryland-Baltimore.

Forest City Enterprises, Inc.

Forest City is a national firm which is currently developing a 278,000-square-foot laboratory facility adjacent to the Johns Hopkins Medical Center in Baltimore. Forest City also developed BioSquare, the flagship wet lab facility used by Boston life science companies. Forest City seeks projects in urban and suburban growth markets, so they would have an interest in Prince George's County projects.

Foulger-Pratt

Foulger-Pratt, located in Rockville, MD develops, builds and manages commercial properties throughout the Washington/Baltimore region. They have several projects underway in the I-270 corridor in Montgomery County and they are working with UMCP on the East Campus Redevelopment project.

Scheer Partners

Locally owned and operated, with offices in Rockville, McLean and Greenbelt, Scheer Partners has provided real estate solutions for the life science industry in the Washington-Baltimore region for nearly 20 years. Services offered by Scheer Partners' Biotech Services group include: real estate advisory, project management, project financing, facilities management, maintenance & consulting, and incubator facility management. Scheer has worked extensively in Mongomery County incubators, including the Maryland Technology Development Center, the Rockville Innovation Center and the Montgomery College Germantown incubator. Given Scheer's biotech focus and proven experience, they should be considered as a potential partner for the county. Charles A. Dukes, Chairman, Executive Committee of Scheer Partners serves as the chair of the PGCEDC Board.

In June 2008 Scheer Partners and JBG Companies created a $100 million equity fund to develop and acquire life science commercial real estate. The fund, called the Greater Washington Life Sciences Fund, will pursuer $300 million in investments in the market. The creation of the Greater Washington Life Sciences Fund allows Scheer and JBG to capitalize on investment and development opportunities. Since its founding in 1991, Scheer has competed more than 500 projects with life sciences companies, totaling over 6.2 million square feet of leasing, acquisition, design and construction projects, as well as operating incubator and laboratory facilities.

17. Public/Private Funding Sources and Incentives

There are many patterns of private/public/nonprofit giving and funding sources used nationally to launch projects similar to the biotechnology research and development center under discussion, such as state grants and corporate or nonprofit organization sponsorship.

17.1 Examples of Funding Approaches Nationally

The following table captures this information for the same representative programs that were discussed in the previous section of this study.

Funding Approaches for Similar Initiatives

Center	Partners	Funding Sources
Central New York Biotechnology Research Center	University of NY Upstate, Medical University State University of New York College of Environmental Science and Forestry Metropolitan Development Association of Syracuse and Central New York	Seed capital from partners, plus Bristol Myers Squibb $20 million from state for the facility
Pennsylvania Biotechnology Center of Bucks County	Hepatitis B Foundation and Delaware Valley College	Initial $7.9 m state grant
Center for Integrated BioSystems at Utah State University	Established as a subdivision of the university by the state legislature	Initial state funding for administrative staff and facilities
BioMedical Research Foundation of Northwest Louisiana	Caddo Parish Commission and the Shreveport Chamber of Commerce	Seed funding from County and Chamber of Commerce

Other public/private funding approaches might include a partnership between an economic development organization and a commercial real estate developer or several developers. This kind of partnership for funding is employed in the development of larger, research park projects.

17.2 Examples of State Incentives for Biotechnology

The state governments provide a range of incentives to support biotechnology industry development, which provides context for the development of BRDC in Prince George's County. These state incentives particularly will tend to center around improving the access to capital through early-stage state investment funds, angel tax credits, business mentoring programs, targeted networking events and workforce training. Many of the construction funds for infrastructure, even at the state level, are federal funds accessed through the U.S. Economic Development Administration (EDA).

Many states, such as Maryland, are making major financial commitments for developing their biotech economies. The Biotechnology Industry Organization summarized some of these other initiatives as shown in the following table.

State Initiatives to Support Their Biotechnology Industries

STATE	INITIATIVE
California	$3B in bond funding for the Institute of Regenerative Medicine
Washington	$350m Life Science Discovery Fund
Pennsylvania	$500m Jonas Salk Legacy Fund
Missouri	$450m Lewis and Clark Discovery Initiative
Ohio	$1.6B Third Frontier Project, 60% bioscience
Michigan	$100m for research, commercialization and infrastructure
44 States & Puerto Rico	Construction of major bioscience research buildings
Arizona	$440m for construction of university research facilities
South Carolina	$220m general obligation bonds for university facilities

Source: BIO report, Growing the Nation's Bioscience Sector: State Bioscience Initiatives, 2006.

17.3 State Incentive Programs for Maryland's Competitors

Incentives offered by states that compete directly against Maryland for life science companies are included in the table below. The incentives are classified as financial, tax, workforce and zone programs.

Incentives	Maryland	Massachusetts	North Carolina	New Jersey	Pennsylvania	Connecticut
FINANCIAL						
Low interest loans	Small Business Development Financing Authority-loans, equity, guarantees, bonds		NC Biotech Center-Loans and matches			$30m fund for financing lab space
	Maryland Economic Development Assistance Authority and fund-loans to business and political jurisdictions					
Grants	Community Development Block Grants	Infrastructure Up to $2 million	Infrastructure Grant Fund		Opportunity Grant Program	
			Job Development Investment Grant	Springboard Fund $50-$250K recoverable grants		
			One North Carolina Fund Governor discretion SBIR/STTR match			
Revolving Loan Fund	Maryland Economic Adjustment Fund-$500K limit 4%					

Incentives	Maryland	Massachusetts	North Carolina	New Jersey	Pennsylvania	Connecticut
FINANCIAL						
Payments		Job Creation Incentive Payment 50% salaries X income tax rate				
Loan Guarantees	Maryland Industrial Dev.Financing Authority	Construction loan guarantees				
Equity	Challenge & Enterprise Investment Program $50-$500K	Limited Partner in Commonwealth Bioventures, Inc.	Research Triangle Park	NJ Econ Dev Authority is Limited Partner in venture capital fund	Biotechnology Regional Greenhouses invest in early stage companies	
	Maryland Venture Fund					
TAX						
Tax Credits	Biotech Investment Tax Credit-income tax credit=50% of investment in early stage companies	Corporate credits for R&D and investment	R&D Credit	R&D Credits	Salable tax credits-10% of R&D spending	Cash in R&D tax credits-65%
	R&D Corporate Income Tax Credit-3% of qualified expenses	Investment tax credit		Tax Certificate Transfers Bio Cos. sell tax losses & R&D credits-75%		
	Job Creation-income tax credit-$1,000/job		Article 3J: Jobs and investment credits	10% corporate credit for investments in unrelated small companies		
	One Maryland-$500K-$5m income tax credits		Renewable Energy, 35%	High tech investment credits		

Incentives	Maryland	Massachusetts	North Carolina	New Jersey	Pennsylvania	Connecticut
TAX						
Tax Exemptions	Machinery/ equipmt. Used in R&D plus R&D Inventory	Sales and property tax exemption for mfg and R&D				Sales tax exemptions for capital goods and supplies
WORKFORCE						
Training Cost Sharing	Business Works- Healthcare industry focus			Business Employment Incentives- 80% of personal income tax for new hires	Job training reimbursement	
ZONES						
	Empowerment & Enterprise Zones- Property & income tax credits, Tax exempt bonds, Workforce training	Economic Target Areas 5% state investment tax credit 5-20 yr property tax exemption	Research Triangle Park Property tax, Equity financeTax exempt bonds	Innovation Zones provide priority for tax credit transfers and Springboard applications	Regional Life Science Greenhouses for early stage companies. $100m from tobacco settlement	Enterprise Zones- corporate & property tax breaks for bio companies in zones with a university
					Keystone Innovation Zones provide tax credits to companies in the zones	

Financial incentives range from outright grants and low interest loans to loan guarantees and equity investments. Several involve the financing of lab space and infrastructure, and others are linked to job creation and capital expenditures. Equity investments are also possible in some states either directly or through limited partnerships in venture capital funds.

Tax incentives include credits and exemptions. Many states offer credits for research and development expenditures and capital investments. Some states offer tax credits to individuals who invest in equity in early state technology companies based on a percentage of the investment. Several states have solved the problem of unprofitable early stage technology companies with no tax liabilities not being eligible for tax

incentives by establishing systems for selling credits at reduced rates to companies that do pay state tax. This system permits these companies to obtain much-needed cash infusions, and it also reduces tax payments for the purchaser. New Jersey also encourages entrepreneurship and spin-offs by offering tax credits for investments in unrelated small companies.

Most states offer some form of sharing workforce training costs when new jobs are created. The state portion is usually some percentage of the salary costs or personal income taxes for new hires.

Many states have designated specific geographic areas for enhanced incentives. Although some zones are defined for urban revitalization purposes, several states have defined areas with research universities and medical institutions to attract technology based companies, including biotech, to encourage the development of collaborative projects. Incentives include tax-exempt bond financing, equity investments, tax credits, workforce training and property tax exemptions.

The use of incentives is controversial in that they redirect public funds for private purposes, and their effectiveness has been questioned. There is evidence of very weak effects of incentive programs on plant relocations. Moreover, tax incentives have not been effective in the attraction of large industrial plants.[66]

However, incentives are most frequently used as a "tie breaker" between jurisdictions in relocation situations, with all other selection criteria being equal. This is particularly true for life science companies which generally have a long path to profitability. This is seen at the state level and at the county level in Maryland. There are numerous cases where early–stage and even incubator stage companies received loans which became incentive grants from Montgomery County to relocate to that jurisdiction.

17.4 Examples of State Funding Assistance

Although biotechnology companies and research centers are eligible for most state programs, there are a growing number of incentives exclusively for bio organizations. Several programs in states that are competitive with Maryland are summarized in the following paragraphs from a survey of state bio incentives conducted by Battelle in 2006 for the Biotechnology Industry Organization (BIO).

Massachusetts

Facilities developed with state funding include a 42,000 square foot headquarters for the Pioneer Valley Life Science Institute, a collaboration of the Bay State Health

[66] Yoonsoo Lee PhD. Dissertation, "Geographic Redistribution of US Manufacturing and the Role of State Development Policy." March 2007.

System and University of Massachusetts (UMass), a 200,000-square-foot life science building at Amherst, a 360,000-square-foot building at the UMass Medical School in Worcester and an expansion of the state's biologic laboratory in Jamaica Plains.

The state's Adams Innovation Institute has provided matching funds for bio research programs at the Pioneer Valley Institute, the MIT Center for Biomedical Innovation (an industry-university partnership) and the Massachusetts Biomanufacturing Center, a five-university collaboration. However, this program is not exclusively for biotechnology projects.

At the regional level, $500,000 loans for biomanufacturing companies are available from the Greater Fall River Development Corporation

North Carolina

Bond funding for the Bioinformatics Research Center in Charlotte – a 70,000 SF $35 million project, a new research and clinical facility for the UNC Chapel Hill Cancer Center ($180 million) and a $60 million facility at East Carolina University for a Cardiovascular Disease Institute.

The North Carolina Biotechnology Center offers grants for biotechnology research at North Carolina universities and for bioscience faculty recruitment. This Center also makes a variety of loans from $25,000 to $250,000 to early stage bio companies for business development, SBIR bridge between Phases 1 and 2, product development, angel investment match company formation. Several require matching funds.

North Carolina created a Life Science Industry Revenue Bonding Authority but has not yet funded it.

New Jersey

New Jersey was the first state to fund research on human embryonic stem cells by providing $5 million from the New Jersey Commission on Science and Technology in grants to 17 research teams making up the New Jersey Stem Cell Institute. The state also invested in facilities at the Coriell Institute of Medical Research in Camden, a life sciences building at Rutgers and a biomedical research building in Camden for the University of Medicine and Dentistry of New Jersey.

Pennsylvania

The Ben Franklin Technology Development Authority has established three regional Life Science Greenhouses using $100 million from the tobacco settlement fund for commercialization of bioscience research. The state is also providing financing for several buildings at universities and hospitals for life science education and research.

Connecticut

The state Department of Community and Economic Development (DCED) provided $300,000, matched by $700,000 from industry to fund a Bioscience Cluster. DCED also has an Office of BioScience to provide business facilitation and recruitment services. The state also funds a stem cell research program.

The $5 million Connecticut BioSeed Fund makes equity investments in early stage biotechnology enterprises.

17.5 Examples of County Incentives

Incentives available at the county level include federal and state incentives but are more limited due to the relatively smaller portion of the total tax burden imposed on corporations and individuals by counties. The following table summarizes county-level incentives available to bio-related and other companies classified in financial, tax, zones and workforce categories in several counties in that compete directly with Prince George's County.

A Comparison of County Incentives for the Biotechnology Industry

Incentives	Prince George's County	Montgomery County MD	Ontario County NY	Fairfax County VA
FINANCIAL				
Low interest loans	Commercial building loan fund	Economic Development Fund $5K-$100K	Industrial Revenue Bonds	
Grants		Tech Growth Program $25-$100K		
Revolving Loan Fund	Small Tech Business Fund	Small Businesses $5-$100K, 5 yrs.	Low interest loans for the purchase of facilities and equipment, working capital, land acquisition, construction, expansion, improvement of land and buildings	

Incentives	Prince George's County	Montgomery County MD	Ontario County NY	Fairfax County VA
TAX				
Tax Credits	State Job Creation Credit-$1500/job	New Jobs Credit-6 yrs		
	Revitalization Tax Credit-Inside Beltway property tax reductions			
	High Technology Incentive Package, with High Tech Real Property Tax Credit	Enhanced New Jobs Credit Large businesses-12 yrs		
Tax Exemptions			Tax abatements-property, sales, use, mortgage	Exclusions for computer and software companies from the business, professional and occupational license tax
WORKFORCE				
Training Cost Sharing		Montgomery Skills Alliance. Pays 50% training costs		
ZONES				
	Enterprise Zones tax credit increased to 5% annual wages. State income & county property tax credits	Enterprise Zones: 10 yr property tax credit, 3 yr income tax credit	Empire Zones-tax credits and other incentives for work force expansion, purchase of new machinery and equipment, reduced sales tax on construction materials and reduced utility costs	

17.6 Funding Contacts for Prince George's County

Historically, some local, regional, state or federal agencies have completely funded projects in Maryland, such as the proposed BRDC. However, the current trend—for financial and political reasons—is toward multiple funding sources. For example, it would be difficult for Montgomery County, MD to develop the 200-acre Shady Grove Life Sciences Center itself as it did in the 1980s when the project was launched.

Funding contacts for the county and its bioscience companies appears in the table on the following page. This list includes state funding sources, as well as national sources, such as the NSF. This list also indicates whether the funding would be for capital development or operational funding.

Both TEDCO and DBED have access to capital and programmatic resources for initiatives, such as the proposed BRDC. The Governor's BioMaryland 2020 initiative will also be a source of financial support for the BRDC. The details of the programs associated with this initiative are under development.

A valuable funding partner for Prince George's County, which is listed with the other funding contacts is the Maryland Economic Development Corporation (MEDCO), a private corporation established in 1984 by the state of Maryland to assist in the expansion, modernization and retention of existing Maryland business and to attract new business to the State. Businesses seeking to expand or relocate into Maryland regularly turn to MEDCO as a resource. MEDCO also assists, upon request, local jurisdiction projects. MEDCO has never assisted Prince George's County Economic Development Corporation with a project and has expressed interest in working with the county.

Each MEDCO project is unique and it structures its transactions on a non-recourse basis. Neither Maryland state agencies nor MEDCO are responsible for the repayment of the bonds that are issued by MEDCO. MEDCO is an eligible borrower and recipient of funds from the Maryland Department of Business and Economic Development. MEDCO supports its operations from fee charges on its various projects and does not receive public funding for its operations.

MEDCO initiated its involvement with technology incubators and accelerators in October 1996, with the inception of the University of Maryland Baltimore County (UMBC) Technology Center Project, in which MEDCO borrowed from DBED and UMBC to purchase the old Lockheed Martin building on South Rolling Road in Baltimore County. Since that time, MEDCO has expanded its role in financing and owning technology incubators and presently owns or operates seven incubators. In fact, MEDCO owns and administers all of the incubators in Montgomery County. MEDCO has contracts with property managers to run and oversee the day to day aspects of these projects. MEDCO maintains oversight and sets new policy for these projects through periodic reviews and communications with project managers.

Organization	Program Name or Description	Contact Information	Eligible activity
Public			
Maryland Technology Development Corporation (TEDCO)	Incubator Development Fund	John Wasilisin, Acting Director 575 Sterrett Place, Suite 240 Columbia MD 21044 jwasilisin@marylandtedco.org 410-715-4173	
Maryland Department of Business and Economic Development (DBED)	Small Business Financing	Les Hall, Jr., Director World Trade Center , 14th Floor Baltimore, MD 21202 lhall@choosemaryland.org 410-767-6356	
	Maryland Life Science Advisory Board	Larry Mahan, PhD., Acting Director World Trade Center, 14th Floor Baltimore, MD 21202 lmahan@choosemaryland.org 410-767-6300 | 1-888-Choose-MD	 In-kind
Maryland Economic Development Corporation (MEDCO)	Construction Bonds and Management	Robert Brennan 100 N. Charles Street, Suite 630 Baltimore, MD 21201 b_brennan@medco-corp.com 410-625-0051	
Prince George's County Economic Development Corporation (PGCEDC)	High Technology Incentive Package	Kwasi Holman, Chief Executive Officer Mercantile Lane- Suite 115A Largo, MD 20774 kholman@pgcedc.com 410-583-4650	
National Science Foundation (NSF)	Partnership for Innovation	Sara B. Nerlove, Program Manager snerlove@nsf.gov 703-292-7077	
Private			
Various corporates	Sponsorships and Partnerships	Members of the Prince George's County corporate community.	

 Capital development funding  Operational funding

17.7 Suggested County Incentives for Biotechnology Companies

Prince George's County's existing financial incentives for all types of companies include industrial revenue bonds, loans and grants tied to investment in facilities and job growth. Tax credits and exemptions can be offered for the variety of taxes at the county level that include real estate, personal property, inventory, income and license taxes on businesses. The county should consider ways to specifically support bioscience companies. For example, grants (which can be tied to job growth) are generally more attractive and useful to early-stage and maturing biotechnology companies which need cash more than traditional tax credits. The PGCEDC should try and add a technology incentive fund ($200-250,000 annually) to its High Technology Incentive Package to attract/retain companies for the county.

Additionally, rather than offer incentives throughout the county, they can be confined to zones designated for special purposes such as the proposed BRDC. For example, Prince George's County's existing High Technology Tax Credit Program could be amended by legislation to make it "zone specific" to the BRDC. The zone could encompass an area larger than the property for the center to encourage suppliers, customers and service providers to locate nearby as an incentive for the development of a biotech cluster.

Workforce incentives can be expected to be particularly important for the county because of the current lack of employment opportunities in biotech research companies. In addition to Ph.D. scientists, the industry also needs laboratory technicians and other support skills.

Montgomery County has successfully attracted, retained and grown a cluster of life science companies over the last 20 years. That county does offer grants and loans ($50,000-$100,000) as incentives to its life science companies, but Montgomery County Department of Economic Development (MCDED) believes that it is the entire package that contributes to its success which includes:

- Availability of trained workforce
- Presence of federal labs and universities
- Availability of appropriate real estate (labs and offices)
- Availability of a wet lab incubator
- Access to early-stage and venture capital

County economic development staff believes that the workforce training offered to employers through the Montgomery County Skills Alliance is critically important for its life science industry employers of new and existing companies.

Incentives are included in the annual budget for MCDED and the return on the investment in these incentives is evaluated each year. The total amount spent on incentives was not available from Montgomery County.

Life science companies in Prince George's County have access to the same federal lab and university resources as Montgomery County companies. They also have access to the same state-supported workforce training resources. The costs of operation for life science companies in Prince George's County also appear to be lower than in neighboring jurisdictions, such as Montgomery County. However, the Montgomery County package currently appears to be more proactively marketed as package than in Prince George's County. If Prince George's County plans to pursue the establishment of a BRDC, it also should allocate some incentive funds (at least $200,000 initially) for biotechnology companies. Moreover, the county will need to develop an integrated marketing program to establish the Prince George's County brand for bioscience industry development and to support the development of the BRDC.

18. Flow Chart for Project Development

This report has highlighted many of the issues associated with the development of a BRDC in Prince George's County. Two general flow charts for the project implementation process have been created: a BRDC Project Plan flowchart for the development of the physical facility and a BRDC Accelerator Plan flowchart for the development of a business accelerator program for companies located at the facility. These charts appear as Appendix X of this report.

18.1 Project Plan

The flow chart for the project plan assumes that the county will develop a BRDC on county-owned land, such as the M-Square site, which has emerged as the preferred site. If the county opts to acquire/purchase additional land adjacent to that site for the project, or selects a site that requires the acquisition/purchase of land, additional implementation steps will be required, which are not included on this flow chart.

Regardless of which site is selected, if the county decides to undertake the development of a BRDC, a small project implementation committee should be established to oversee the project, as multiple organizations will need to be actively engaged in the process over a period of time. This working committee should include key stakeholders, including a representative of the county's executive branch, PGCEDC, the Planning Department, UMCP if the M-Square site is ultimately selected, and several private sector members. The County Executive may want to appoint the chairman of the committee. As this is an economic development project, PGCEDC should play a leadership role in the process.

18.2 Accelerator Plan

The flow chart for the development of the BRDC accelerator program begins with a feasibility study specifically for the wet lab accelerator component of the project. While this study will obviously draw on the current study work and it can be structured with some flexibility, it is a prerequisite for future TEDCO and DBED funding for program and facility construction.

The initial development and guidance of the BRDC accelerator program should be managed by PGCEDC until a decision is made about the actual operational structure of the accelerator program. This model has worked successfully in neighboring counties launching similar projects.

APPENDICES

APPENDIX I:

Inventory of Federal Research Laboratories in Study Area

Beltsville Agricultural Research Center (BARC)

According to the USDA's Agricultural Research Service's website, BARC is "the largest and most diversified agricultural research complex in the world."[67] The research conducted at BARC aims to develop solutions to priority agricultural problems and to disseminate these solutions in order to increase food and agricultural product safety as well as to improve the economics of the nation's agricultural economy while at the same time enhancing natural resources and the environment. Areas of BARC research include the following (among others):

- Air Quality,
- Animal Health,
- Crop Production, Protection & Quarantine,
- Food Safety,
- Global Change,
- Human Nutrition, and
- Water Resource Management.

Center for Food Safety and Applied Nutrition (Food & Drug Administration)

Located in College Park, the FDA's Center for Food Safety and Applied Nutrition (CFSAN) is tasked with securing the nation's food supply and ensuring that food and cosmetic products are safe and properly labeled. In fact, CFSAN is responsible for the regulation of more than 30,000 U.S. food manufacturers and processors as well as 3,500 cosmetic companies. The Center regulates $270 billion in domestic and imported foods and cosmetic products. Among the Center's main regulatory tasks are:

- Safety of substances added to foods;
- Safety of foods and ingredients developed through biotechnology;
- Regulating the proper labelling of foods;

[67] http://www.ars.usda.gov/AboutUs/AboutUs.htm?modecode=12-00-00-00

- Seafood hazard analysis; and
- Regulation and research of health risks associated with food borne chemical and biological contaminants.[68]

NASA Goddard Space Flight Center

Located in Greenbelt, Maryland, the NASA Goddard Space Flight Center was established in 1959. The center encompasses 1,200 acres of land with over 3,000,000 square feet of space within 33 buildings. According to their website, NASA Goddard houses the nation's "largest organization of combined scientists and engineers dedicated to learning and sharing their knowledge of the Earth, solar system, and Universe."[69] Components of the Center's mission include:

- Develop and operate a range of flight missions;
- Conduct research in the space and Earth science disciplines;
- Provide and operate spaceflight tracking and data acquisition networks;
- Develop and maintain information systems to display, analyze, archive and distribute Earth science data and
- Develop National Oceanic and Atmospheric Administration (NOAA) satellite systems for forecasting and research purposes.[70]

National Institutes of Health (NIH)

The National Institute of Health is the principal Federal agency providing financial support for and performing medical research. Its goal is to foster medical discoveries that improve human health and save lives. The headquarters is situated on 310 acres in Bethesda, Maryland and is home to 27 different institutes and centers, each with their own mission.[71] NIH endows $28 billion annually to hospitals, universities and other institutions in the United States and around the world to be used in conjunction with medical research.[72]

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[68] http://www.cfsan.fda.gov/~lrd/cfsan4.html

[69] http://www.nasa.gov/centers/goddard/about/index.html

[70] http://www.nasa.gov/centers/goddard/about/index.html

[71] http://www.nems.nih.gov/aspects/nat_resources/

[72] http://www.nih.gov/about/NIHoverview.html

Naval Medical Research Center (NMRC)

The Naval Medical Research Center, located in Silver Spring, Maryland, shares a state of the art facility with the Walter Reed Army Institute of Research. Both institutes focus on biomedical research but differ in their ultimate goals.

The 474,000 square foot facility that houses the two institutes, can double in size, if need be, through interstitial space between its four floors. The Naval Medical Research center focuses its research on finding solutions to both conventional medical problems and those encountered in a military situation. The centers mission is to enhance, promote and apply basic and applied biomedical research for infectious diseases, biological defense, combat casualty, etc. [73]

Walter Reed Army Institute of Research (WRAIR)

Located within the same facility as the Naval Medical Research Center, the Walter Reed Army Institute of Research is another military agency focusing its research on biomedical matters. Its primary emphasis is on conducting biomedical research that adheres to the Department of Defense and U.S. Army requirements.

WRAIR's mission is to develop life sustaining products that prolong a war-fighters combat usefulness through knowledge, technology or medical material. WRAIR has a variety of research focuses, all of which are relevant to war fighters. These focuses are:

- Psychiatry and Neuroscience
- Military Casualty Research
- Preventive Medicine, and
- Retro virology[74]

U.S. Army Medical Research and Material Command (Ft. Detrick)

The U.S. Army Medical Research and Material Command, located in Frederick, Maryland is part of Fort Detrick, and concentrates its resources on biomedical technology. The center conducts biomedical research and development for medical solutions needed now and in the future to enhance, protect and treat or heal war fighters. The 1,200 acres encompassing the center provides office space, labs, and

[73] http://www.nmrc.navy.mil/

[74] http://wrair-www.army.mil/

open green spaces.[75] The center's core military research and development program focuses on four Research Area Directorates:

- Military Infectious Diseases Research Program
- Combat Casualty Care Research Program
- Military Operation Medicine Research Program
- Chemical Biological Defense Partnership Support Directorate[76]

Department of Energy (DOE)

The Department of Energy, located in Germantown, Maryland, sits on 109 acres with 516,000 square feet of floor space.[77] The DOE's main mission is to advance national, economic and energy security for the nation. In addition the DOE also works to encourage scientific and technological innovation to supports its mission and to ensure proper environmental cleanup of national nuclear weapons is adhered. To achieve its goals, the DOE uses joint initiatives with other governmental or private programs. A few of the current initiatives are:

- Energy Start
- FreedomCAR and Fuel Partnership
- Climate Vision
- Partnerships for Home Energy Efficiency
- Carbon Sequestration Leadership Forum[78]

National Institute of Genome Research

The National Institute of Genome Research was established to contribute to the sequencing of the human genome. Since its successful completion in April of 2003, the institute has refocused its mission to understanding the structure and function of the human genome and what role it plays in health and disease. In addition, the institute continues to study the ethical, legal and social implications that stem from genome research. The facility is located on the NIH campus in Bethesda, Maryland.[79]

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[75] http://www.detrick.army.mil/cutting_edge/chapter3.cfm

[76] https://mrmc-www.army.mil/mrdindex.asp

[77] http://www.science.doe.gov/sc-80/trail/history.htm

[78] http://www.energy.gov/about/jointinitiatives.htm

[79] http://www.genome.gov/10001022

Defense Advanced Research Projects Agency

The Defense Advanced Research Projects Agency, located in Arlington, Virginia, focuses its resources on national defense. Its mission is to bridge the gap between fundamental discovery and military use. The agency works to maintain technological superiority of the U.S. military and to prevent technological surprises from harming national security.

National Science Foundation (NSF)

The National Science Foundation, located in Arlington, Virginia, is a supporter of education and fundamental research in all scientific and engineering disciplines. The foundation focuses on all aspects of these fundamentals except for medical sciences. Its primary purpose is to dole out federal funding from an annual budget of about $5.6 billion per year. NSF typically awards 10,000 new grants each year. The foundation also conducts research of various science and engineering statistics, including education, R&D, industry trends, etc.

Office of Naval Research

The Office of Naval Research conducts scientific research and advanced technological development with an emphasis on maritime applications. Their mission is to foster, plan, facilitate and translate scientific research to ensure that future naval operations have the power and ability to preserve national security. The office is located in Arlington, Virginia with 5,000 square feet of lab space.[80]

U.S. Department of Defense: Research & Engineering

The U.S. Department of Defense: Research and Engineering was established in 1947 to ensure that fighters of war would have superior and affordable technology to support their missions.[81] The agency's main focus is on national defense and it pursues this goal through 6 organizations it oversees. These organizations are:

- Advanced Systems and Concepts
- Laboratories and Basic Sciences
- Science and Technology

[80] http://www.onr.navy.mil/about/

[81] http://www.dod.mil/ddre/mission.htm

- Plans and Programs
- Defense Technical Information Center
- Defense Advanced Research Projects Agency[82]

National Security Agency (NSA)

The National Security Agency is a high tech, cryptology organization at the forefront of communications and data processing. The primary purpose of NSA is national defense. Currently the facility is located in sprawling complex just outside of Fort Meade in Anne Arundel County. The agency is set to move within the gates of Fort Meade, by 2009, as part of the pentagons realignment and consolidate of defense operations.[83] The vision of the NSA is to:

- Dominate cryptology globally
- Secure national security systems
- Connect people, sensors, systems and information on a global scale, and
- Leverage unique relationships with government, industry, academia and foreign partners.[84]

National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology was created to promote U.S. innovation and industrial competitiveness. NIST is located in Gaithersburg, Maryland on 578 acres. The institute works to advance measurement science, standards and technology in order to boost economic security and improve upon quality of life. NIST achieves its goals through four cooperative programs:

- NIST Laboratories: advance nation's tech infrastructure
- Baldridge National Quality Program: promote performance excellence among U.S. manufacturers
- Hollings Manufacturing Extension Program: network that offers tech and business assistance to small manufacturers
- Advanced Technology Program: co-funds R&D partnerships with private sector[85]

[82] http://www.dod.mil/ddre/orgchart.htm

[83] http://www.globalsecurity.org/org/news/2005/051112-nsa-move.htm

[84] http://www.nsa.gov/about/about00006.cfm

[85] http://www.nist.gov/public_affairs/general2.htm

Naval Surface Warfare Center Carderock Division (NSWC-CD)

The Naval Surface Warfare Center, Carderock Division is located on 184 acres in Bethesda, Maryland. The facility provides fleet support through R&D, test and evaluation. In most recent years, NSWC-CD has become the Navy's prime source for surface water and undersea vehicle hull and propulsion research. Their primary focuses in research are:

- Hydrodynamics
- Hydracoustics
- Structures and materials
- Hull and propulsion signatures
- Vehicle design[86]

[86] http://www.mde.state.md.us/assets/document/NSWC_Carderock.pdf

APPENDIX II:

Research and Development Funding by Educational Institution

R & D Expenditures in the Sciences and Engineering, by Field, Separately Budgeted: Fiscal Year 2007

	University of Maryland College Park	University of Maryland Baltimore	University of Maryland Baltimore County	Georgetown University	Howard University	George Washington University	**Total**
All Fields	$272,795,869	$358,851,000	$66,968,000	$131,785,000	$38,020,000	$126,110,000	**$994,529,869**
Computer Sciences	$33,720,000	$0	$3,684,000	$51,000	$0	$1,492,000	**$38,947,000**
Environmental Sciences	$14,422,000	$0	$27,373,000	$0	$0	$3,000	**$41,798,000**
Life Sciences	$66,733,000	$358,851,000	$5,455,000	$120,423,000	$28,407,000	$49,146,000	**$629,015,000**
Agricultural Sciences	$43,584,000	$0	$0	$0	$0	$0	**$43,584,000**
Biological Sciences	$15,576,000	$53,828,000	$5,455,000	$13,916,000	$16,140,000	$14,971,000	**$119,886,000**
Medical Sciences	$0	$287,081,000	$0	$99,706,000	$12,013,000	$34,175,000	**$432,975,000**
Life Sciences	$7,573,000	$17,942,000	$0	$6,801,000	$254,000	$0	**$32,570,000**
Mathematical Sciences	$6,626,000	$0	$1,698,000	$216,000	$221,000	$51,672,000	**$60,433,000**
Physical Sciences	$65,454,000	$0	$8,211,000	$2,541,000	$3,640,000	$3,690,000	**$83,536,000**
Psychology	$4,399,000	$0	$2,248,000	$1,182,000	$0	$2,153,000	**$9,982,000**
Social Sciences	$80,537,000	$0	$6,924,000	$7,372,000	$0	$7,390,000	**$102,223,000**
Sciences	$0	$0	$2,755,000	$0	$1,105,000	$815,000	**$4,675,000**
Engineering	$87,869	$0	$8,620,000	$0	$4,647,000	$9,749,000	**$23,103,869**
Bioengineering/Biomedical Engineering	$817,000	$0	$0	$0	$0	$0	**$817,000**
Rank*	46	47	151	113	186	116	

Source: National Science Foundation, Division of Science Research Statistics, "Academic Research and Development Expenditures: Fiscal Year 2007", 2008.

* Ranked by total R&D expenditures for the 662 institutions that responded to the survey.

R & D Expenditures in the Sciences and Engineering, by Source of Funds, Separately Budgeted: Fiscal Year 2007

	University of Maryland College Park	University of Maryland Baltimore	University of Maryland Baltimore County	Georgetown University	Howard University	George Washington University	**Total**
All Sources	$359,760,000	$358,851,000	$66,968,000	$131,785,000	$38,020,000	$126,110,000	**$1,081,494,000**
Federal Government	$218,973,000	$164,211,000	$49,461,000	$101,853,000	$33,996,000	$87,624,000	**$656,118,000**
Industry	$10,869,000	$31,968,000	$815,000	$3,441,000	$2,033,000	$3,098,000	**$52,224,000**
Institutional Funds	$99,244,000	$90,550,000	$12,465,000	$13,872,000	$0	$10,831,000	**$226,962,000**
State and Local Government	$20,663,000	$19,337,000	$2,161,000	$1,614,000	$491,000	$2,289,000	**$46,555,000**
All Other Sources	$10,011,000	$52,785,000	$2,066,000	$11,005,000	$1,500,000	$22,268,000	**$99,635,000**

Source: National Science Foundation, Division of Science Research Statistics, "Academic Research and Development Expenditures: Fiscal Year 2007", 2008.

APPENDIX III:

Academic and other Research Centers in the Study Area

Study Area Academic & Other Resources								
Facility	**Primary Function**	**Research Focus**	**Mission**	**Market Niche**	**Square Footage or Acreage**	**Type of Space**	**Type of Center**	**Location**
Johns Hopkins Applied Physics Laboratory (APL)	Homeland Security	400 different programs that protect homeland security and advance nation's vision in research and space science.	Solve complex problems that present critical challenges to nation.	Research, engineering and development.	399 acres, 5,000 sq. ft. of test and evaluation lab dedicated to biomechanics	Variety of labs ranging from Microbiological analysis to Quantum Optics.	Private Institution	Howard
Shady Grove Life Sciences Center	Life Sciences and Biotechnology	Business park zoned exclusively for biotech and life science industries, home to private companies, incubator, and educational institutions.	First business park in US zoned exclusively for biotech and life sciences industries.	Cluster for companies, educational facilities and an incubator.	300 acres	Healthcare facilities, research and educational centers, R&D facilities, labs	Private Institution	Montgomery

University of Maryland Biotechnology Institute	Biotechnology	Conduct groundbreaking research, generate innovative solutions, and develop new technologies for commercial application.	Provide environment for specialized training and mentoring tomorrow's biotech workforce while promoting economic growth.	Facilities, research.	Comprises 5 research centers between Montgomery and Baltimore, approx. 245,000 sq. ft. combined.	Wet labs, research labs, etc., office space	Public Institution	Montgomery
bwtech@UMBC Research and Technology Park	Research and Technology	Provide space for companies that have synergy with UMBC in technology and bioscience areas.	Provide environment for specialized training and fostering economic growth for area.	Access to University resources, education and training	41 acres, development capacity 330,000 sq. ft.	5 buildings with offices and lab space.	Public Institution	Baltimore County
Georgetown University Medical Center	Biomedical Research	Focuses on two research categories, Cancer and the more broad biomedical.	Foster cutting-edge interdisciplinary collaboration and enhance basic science and translational research capacity.	R&D, facilities.	More than 240,000 sq. ft. combined.	Lab, clinic and office space.	Private Institution	Washington, D.C.
George Washington University Medical Center (SPHHS)	Public Health	Applied research in public health and health services.	To work collaboratively with other scholars, advocates, policymakers, legislators, the private sector and others in the community on multidisciplinary types of research.	R&D, facilities.	Multiple facilities across campus on 43 acres.	Lab, clinic and office space.	Private	Washington, D.C.

APPENDIX IV:

Research Space in Academic Institutions

Science and Engineering Research Space in Academic Institutions, by State, Control, Institution, and Field: FY 2005

(Net assignable square feet in thousands)

State, control, and institution	All fields	Agricultural sciences	Biological sciences	Computer sciences	Earth, atmospheric, and ocean sciences	Engineering	Mathematic	Medical sciences	Physical sciences	Psychology	Social sciences
Public	**2,072**	**367**	**510**	**75**	**33**	**250**	**16**	**510**	**217**	**41**	**53**
U. MD Baltimore	643	0	183	0	0	0	0	446	0	0	14
U. MD Baltimore County	188	0	41	44	0	30	1	0	54	15	3
U. MD Biotechnology Institute	254	36	157	1	3	4	0	53	0	0	0
U. MD College Park	987	331	129	30	30	216	15	11	163	26	36
Private											
Georgetown U.	**300**	**0**	**106**	**1**	**0**	*****	*****	**164**	**20**	**2**	**7**

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities , Fiscal Year 2005.

* = greater than 0, but less than 500.

NOTES: Details may not add to totals due to rounding.
These data are unadjusted; the totals of these data will not match the totals in tables with weighted and imputed data.

APPENDIX V:

University Licensing in the Study Area 2003-2005

Name of Institution	2005 Research Expenditures	2003-2005 Cumulative Total Research Expenditures	Licenses & Options Executed	Cumulative Active Licenses	Start-ups	2003-2005 Cumulative Invention Disclosures	US Patents Issued	New Patent Applications	2003-2005 Cumulative Adjusted Gross Income	License Income
University of Maryland College Park	$309,898,312	$881,445,543	43	197	7	326	23	31	$2,621,254	$962,516
University of Maryland, Baltimore	$404,427,715	$1,067,594,756	23	64	3	251	7	100	$531,013	$251,388
University of Maryland, Baltimore County	$58,467,000	$150,776,000	7	30	0	90	1	30	$153,514	$87,817
Georgetown University	$122,672,973	$377,366,012	14	40	2	259	21	73	$382,631	$193,132
Total	$895,466,000	$2,477,182,311	87	331	12	926	52	234	$3,688,412	$1,494,853

Source: AUTM Survey for 2005. This survey does not include Howard University or George Washington University.

APPENDIX VI:

Explanation of IMPLAN Model

IMPLAN is an economic impact assessment software system. The system was originally developed and is now maintained by the Minnesota IMPLAN Group (MIG). It combines a set of extensive databases concerning economic factors, multipliers and demographic statistics with a highly refined and detailed system of modeling software. IMPLAN allows the user to develop local-level input-output models that can estimate the economic impact of new firms moving into an area as well as the impacts of professional sports teams, recreation and tourism, and residential development. The model accomplishes this by identifying direct impacts by sector, then developing a set of indirect and induced impacts by sector through the use of industry-specific multipliers, local purchase coefficients, income-to-output ratios, and other factors and relationships.

There are two major components to IMPLAN: data files and software. An impact analysis using IMPLAN starts by identifying expenditures in terms of the sectoring scheme for the model. Each spending category becomes a "group" of "events" in IMPLAN, where each event specifies the portion of price allocated to a specific IMPLAN sector. Groups of events can then be used to run impact analysis individually or can be combined into a project consisting of several groups.

In terms of Biotechnology Center operations, these events and groups would be items such as operations and capital investments of the firms, expenditures by and employees of the Biotechnology Center, and employee housing expenditures. Once the direct economic impacts have been identified, IMPLAN can calculate the indirect and induced impacts based on a set of multipliers and additional factors.

The hallmark of IMPLAN is the specificity of its economic datasets. The database includes information for five-hundred-and-twenty-eight different industries (generally at the three or four digit Standard Industrial Classification level), and twenty-one different economic variables. Along with these data files, national input-output structural matrices detail the interrelationships between and among these sectors. The database also contains a full schedule of Social Accounting Matrix (SAM) data. All of this data is available at the national, state, and county level.

Another strength of the IMPLAN system is its flexibility. It allows the user to augment any of the data or algorithmic relationships within each model in order to more precisely account for regional relationships. This includes inputting different output-to-income ratios for a given industry, different wage rates, and different multipliers where appropriate. IMPLAN also provides the user with a choice of trade-flow assumptions, including the modification of regional purchase coefficients, which determine the mix of goods and services purchased locally with each dollar in each sector. Moreover, the system also allows the user to create custom impact analyses by entering changes in final demand. This flexibility is a critically important feature in terms of the RESI proposed approach. RESI is uniquely qualified to develop data and factors

tailored to this project, and, where appropriate, overwrite the default data contained in the IMPLAN database.

IMPLAN is highly credible and widely accepted within the field. There are over five hundred active users of IMPLAN databases and software within the federal and state governments, universities, and among private sector consultants. A sample list of IMPLAN users includes:

Academic Institutions
Alabama A&M University
Albany State University
Auburn University
Cornell University
Duke University
Iowa State University
Michigan State University
Ohio State
Penn State University
Portland State University
Purdue University
Stanford University
Texas A&M University
University of CA - Berkeley
University of Wisconsin
University of Minnesota
Virginia Tech
West Virginia University
Marshal University College of Business

State Governments
Maryland Department of Natural Resources
Missouri Department of Economic Development
California Energy Commission
Florida Division of Forestry
Illinois Department of Natural Resources
New Mexico Department of Tourism
South Carolina Employment Security
Utah Department of Natural Resources
Wisconsin Department of Transportation

Federal Government
Argonne National Lab
Federal Emergency Management Agency
U.S. Dep't of Agriculture, Forest Research
U.S. Dep't of Agriculture, Econ Research Service
U.S. Dep't of Interior, Bureau of Land Management
U.S. Dep't of Interior, Fish and Wildlife Service
U.S. Dep't of Interior, National Park Service
U.S. Army Corp of Engineers

Private Consulting Firms
Cooper & Lybrand
Batelle Pacific NW Laboratories
Boise Cascade Corporation
Charles River Associates
CIC Research
BTG/Delta Research Division
Crestar Bank
Deloitte & Touche
Ernst & Young
Jack Faucett Associates
American Economics Group Inc.
L.E. Peabody Associates
The Kalorama Consulting Group
West Virginia Research League

APPENDIX VII:

Detailed Impact Tables for Economic Impact Determination

Maryland - Annual Employment Impacts[87]

Maryland - Total Employment Impacts, by Industry			
Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	0	1	0
Mining	0	0	0
Utilities	2	4	2
Construction	7	17	6
Manufacturing	8	18	6
Wholesale Trade	16	36	13
Transportation & Warehousing	31	72	26
Retail Trade	82	193	71
Information	10	24	9
Finance & insurance	18	41	15
Real Estate & Rental	38	88	32
Professional- Scientific & Tech Services	776	1,814	665
Management of Companies	5	11	4
Administrative & Waste Services	104	244	89
Educational Services	12	27	10
Health & Social Services	71	167	61
Arts- Entertainment & Recreation	23	54	20
Accommodation & food services	64	151	55
Other Services	42	97	36
Government & Non-NAICs	6	14	5
Institutions	0	0	0
Total	*1,315*	*3,073*	*1,125*

[87] Numbers may not add up due to rounding.

Maryland - Annual Labor Income Impacts, in millions of 2006 dollars[88]

Maryland - Total Labor Income Impacts, by Industry Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	$0.0	$0.0	$0.0
Mining	$0.0	$0.0	$0.0
Utilities	$0.2	$0.5	$0.2
Construction	$0.4	$1.0	$0.4
Manufacturing	$0.5	$1.1	$0.4
Wholesale Trade	$1.1	$2.5	$0.9
Transportation & Warehousing	$1.2	$2.9	$1.1
Retail Trade	$2.5	$5.7	$2.1
Information	$0.7	$1.6	$0.6
Finance & insurance	$1.1	$2.5	$0.9
Real Estate & Rental	$1.3	$3.1	$1.1
Professional- Scientific & Tech Services	$59.0	$138.0	$50.6
Management of Companies	$0.4	$0.9	$0.3
Administrative & Waste Services	$3.7	$8.6	$3.1
Educational Services	$0.3	$0.7	$0.3
Health & Social Services	$3.1	$7.2	$2.6
Arts- Entertainment & Recreation	$0.3	$0.8	$0.3
Accommodations & food services	$1.3	$3.0	$1.1
Other Services	$1.3	$3.1	$1.2
Government & Non-NAICs	$0.3	$0.8	$0.3
Institutions	$0.0	$0.0	$0.0
Total	*$78.7*	*$184.0*	*$67.4*

[88] Numbers may not add up due to rounding.

Maryland - Annual Output Impacts, in millions of 2006 dollars[89]

Maryland - Total Output (GDP) Impacts, by Industry Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	$0.0	$0.1	$0.0
Mining	$0.0	$0.0	$0.0
Utilities	$1.1	$2.7	$1.0
Construction	$1.0	$2.4	$0.9
Manufacturing	$1.6	$3.8	$1.4
Wholesale Trade	$2.8	$6.5	$2.4
Transportation & Warehousing	$2.4	$5.6	$2.0
Retail Trade	$6.0	$13.9	$5.1
Information	$3.0	$7.0	$2.6
Finance & insurance	$3.6	$8.3	$3.1
Real Estate & Rental	$7.6	$17.9	$6.5
Professional- Scientific & Tech Services	$116.4	$272.0	$99.7
Management of Companies	$0.9	$2.1	$0.8
Administrative & Waste Services	$7.7	$18.0	$6.6
Educational Services	$0.6	$1.4	$0.5
Health & Social Services	$5.7	$13.4	$4.9
Arts- Entertainment & Recreation	$0.8	$1.8	$0.6
Accommodation & food services	$3.7	$8.6	$3.1
Other Services	$2.9	$6.7	$2.5
Government & Non-NAICs	$7.6	$17.8	$6.5
Institutions	$0.0	$0.0	$0.0
Total	*$175.4*	*$410.0*	*$150.3*

[89] Numbers may not add up due to rounding.

Prince George's County - Annual Employment Impacts[90]

Prince George's County - Total Employment Impacts, by Industry			
Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	0	0	0
Mining	0	0	0
Utilities	1	1	1
Construction	2	4	2
Manufacturing	1	2	1
Wholesale Trade	3	7	2
Transportation & Warehousing	8	20	7
Retail Trade	16	38	14
Information	2	5	2
Finance & insurance	2	4	2
Real Estate & Rental	6	15	5
Professional- Scientific & Tech Services	720	1,682	616
Management of Companies	1	2	1
Administrative & Waste Services	19	45	16
Educational Services	1	3	1
Health & Social Services	10	24	9
Arts- Entertainment & Recreation	4	9	3
Accommodation & food services	11	26	10
Other Services	7	16	6
Government & Non-NAICs	2	4	1
Institutions	0	0	0
Total	*816*	*1,907*	*699*

[90] Numbers may not add up due to rounding.

Prince George's County - Annual Labor Income Impacts, in 2006 dollars[91]

Prince George's County - Total Labor Income Impacts, by Industry			
Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	$0.0	$0.0	$0.0
Mining	$0.0	$0.0	$0.0
Utilities	$0.1	$0.2	$0.1
Construction	$0.1	$0.3	$0.1
Manufacturing	$0.1	$0.2	$0.1
Wholesale Trade	$0.2	$0.5	$0.2
Transportation & Warehousing	$0.3	$0.8	$0.3
Retail Trade	$0.5	$1.1	$0.4
Information	$0.1	$0.3	$0.1
Finance & insurance	$0.1	$0.3	$0.1
Real Estate & Rental	$0.2	$0.5	$0.2
Professional- Scientific & Tech Services	$55.2	$129.1	$47.3
Management of Companies	$0.1	$0.2	$0.1
Administrative & Waste Services	$0.7	$1.6	$0.6
Educational Services	$0.0	$0.1	$0.0
Health & Social Services	$0.4	$1.0	$0.4
Arts- Entertainment & Recreation	$0.1	$0.1	$0.0
Accommodation & food services	$0.2	$0.5	$0.2
Other Services	$0.2	$0.5	$0.2
Government & Non-NAICs	$0.1	$0.2	$0.1
Institutions	$0.0	$0.0	$0.0
Total	*$58.7*	*$137.4*	*$50.3*

[91] Numbers may not add up due to rounding.

Prince George's County - Annual Output Impacts, in 2006 dollars[92]

Prince George's County - Total Output (GDP) Impacts, by Industry Sector	M-Square	Prince George's Plaza	Konterra
Agriculture, Forestry, Fish & Hunting	$0.0	$0.0	$0.0
Mining	$0.0	$0.0	$0.0
Utilities	$0.4	$1.0	$0.4
Construction	$0.3	$0.6	$0.2
Manufacturing	$0.2	$0.5	$0.2
Wholesale Trade	$0.5	$1.2	$0.4
Transportation & Warehousing	$0.7	$1.5	$0.6
Retail Trade	$1.2	$2.7	$1.0
Information	$0.6	$1.4	$0.5
Finance & insurance	$0.4	$0.9	$0.3
Real Estate & Rental	$1.3	$3.0	$1.1
Professional- Scientific & Tech Services	$108.5	$252.9	$92.7
Management of Companies	$0.2	$0.4	$0.1
Administrative & Waste Services	$1.4	$3.3	$1.2
Educational Services	$0.1	$0.1	$0.1
Health & Social Services	$0.8	$2.0	$0.7
Arts- Entertainment & Recreation	$0.1	$0.3	$0.1
Accommodation & food services	$0.6	$1.5	$0.6
Other Services	$0.5	$1.1	$0.4
Government & Non-NAICs	$2.2	$5.2	$1.9
Institutions	$0.0	$0.0	$0.0
Total	*$120.4*	*$279.6*	*$102.5*

[92] Numbers may not add up due to rounding.

APPENDIX VIII:

List of Stakeholder Interviews

County and State Government

Camille Exum, Chair, Prince George's County Council
Samuel Dean, Chair, Prince George's County Council
Thomas Dernoga, Vice Chair, Prince George's County Council
Eric Olson, Councilman, Prince George's Council
Kwasi Holman, Prince George's County Economic Development Corporation
David Edgerley, Secretary, Maryland DBED
Larry Mahan, Biotechnology Industry Specialist, Maryland DBED
Renee Winsky, Executive Director, Maryland TEDCO
Robert Brennan, Executive Director, Maryland Economic Development Corporation (MEDCO)
Janis Peters, Senior Business Development Specialist, Montgomery County Economic Development

Universities and Training Institutes

Brian Darmody, Associate VP, Research and Economic Development, UMCP
Martha Connolly, Executive Director, Maryland Industrial Partnerships, UMCP
Kathleen Weiss, Director, Biotechnical Institute of Maryland
Ted Poehler, Vice Provost for Research, Johns Hopkins University
Sarah Djamshidi, Director, TAP Incubator, UMCP

Research Institutes

Phyllis Johnson, Director, USDA Beltsville Agricultural Research Center (BARC)
William Bentley, Director, Bio-Engineering, UMCP
Mary Poos, Director, Academic Partnerships, Food and Drug Administration
Neil Weissman, Executive Director, Medstar Research Institute

Industry

Vipin Adhlakha, Human Resources, BioServe
Ted Olson, CEO, Innovative BioSensors, Inc.
Terry Chase, President, Chesapeake Perl
Hui Ge, VP and Chief Scientific Officer, Protein One
Scott Weisman, Vice President, Business Development, BioSet, Inc.
Robert Eaton, Former President, MdBio, Inc.

Real Estate and Developers

Hillary Colt Cahan, Konterra Development
Dave Wills, NAI Michael
Kathy Doyle, Forest City Science and Technology Group
Bryant Foulger, Principal, Foulger-Pratt
Doug Firstenberg, Principal, Stonebridge Associates, Inc.

APPENDIX IX:

Glossary of Selected Terms Used in this Report

Scientific and Technical Terms used in this Report

Biotechnology and Bioscience -The term "biotechnology" is often not used in a standard or uniform way. Over the past few years, the use of the term "biotechnology" has become quite broad and covers topics from drug discovery and drug production to medical devices and agricultural sciences.

The Biotechnology Industry Organization's (BIO) definition of biotechnology[93] is:

> "Biotechnology---the use of cellular and bio-molecular processes to solve problems or make useful products. Biotechnology is a collection of technologies that capitalize on the attributes of cells, such as their manufacturing capabilities, and put biological molecules, such as DNA and proteins, to work for us."

Examples of specific biotechnologies (as cited by BIO) include the following:

- Bioprocessing Technology
- Monoclonal Antibodies
- Cell Culture
- Recombinant DNA Technology
- Cloning
- Protein Engineering
- Biosensors
- Nanobiotechnology
- Micro arrays

The applications for such technologies are broad and range from healthcare and agriculture applications to biodefense, bioengineering, industrial and environmental applications.

Maryland's bioscience association, MdBio, has elected to use a very inclusive term "bioscience" and DBED has also adopted this terminology. By their definition, a bioscience organization is biology driven and its activity substantially involves research, development or manufacture of: 1) biologically active molecules; 2) devices that employ or affect biological processes; 3) biological information resources or 4) software designed specifically for biological applications.

In benchmarking reports on this industry sector[94], the Brookings Institution and Battelle use the terms "biotechnology" and "biosciences" when discussing the industry. Moreover, as Maryland

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[93] *Guide to Biotechnology 2008,* Bio Industry Association

DBED also uses these terms interchangeably, "biotechnology" and "bioscience" will be used interchangeably in this report, to be consistent with terminology used by Maryland DBED.

Bioengineering-Bioengineering is an emerging area that draws from various scientific disciplines and includes the integration of physical, chemical or mathematical sciences and engineering principles for the study of biology, medicine, behavior or health.[95]

Nanotechnology -Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.

A nanometer is one-billionth of a meter. A sheet of paper is about 100,000 nanometers thick; a single gold atom is about a third or a nanometer in diameter. Dimensions between approximately 1 and 100 nanometers are known as the nanoscale. Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules.[96]

Nanomedicine- NIH defines the term, nanomedicine as an offshoot of nanotechnology, referring to highly specific medical interventions at the molecular scale for curing disease or repairing damaged tissues, such as bone, muscle, or nerve[97].

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[94] *Signs of Life: The Growth of Biotechnology Centers in the US, 2002,* The Brookings Institution and *Growing the Nation's Bioscience Sector: State Bioscience Initiatives*, 2006, Battelle

[95] National Institutes of Health website.

[96] National Nanotechnology Initiative (NNI) definition.

[97] National Institutes of Health Roadmap for Medical Research in Nanomedicine, 2006.

Zoning Categories referenced in the report:

E-I-A: Employment and Institutional Area - A concentration of nonretail employment and institutional uses and services such as medical, manufacturing, office, religious, educational, recreational, and governmental.

M-U-I: Mixed-Use Infill - Promotes Smart Growth principles by encouraging the efficient use of land, public facilities and services in areas that are substantially developed. These regulations are intended to create community environments enhanced by a mix of residential, commercial, recreational, open space, employment and institutional uses in accordance with approved plans. The infill zone may only be approved for property located in a Transit District Overlay Zone or a Development District Overlay Zone.

M-X-T: Mixed Use - Transportation Oriented - Provides for a variety of residential, commercial, and employment uses; mandates at least two out of the following three use categories: (1) Retail businesses; (2) Office/ Research/Industrial; (3) Dwellings, hotel/motel; encourages a 24-hourfunctional environment; must be located near a major intersection or a major transit stop or station and will provide adequate transportation facilities for the anticipated traffic or at a location for which the applicable Master Plan recommends mixed uses similar to those permitted in the M-X-T Zone.

O-S: Open Space - Provides for areas of low-intensity residential (5 acre) development; promotes the economic use and conservation of land for agriculture, natural resource use, large-lot residential estates, nonintensive recreational use.

R-55: One-Family Detached Residential - Permits small-lot residential subdivisions; promotes high density, single-family detached dwellings.

T-D-O: Transit District Overlay - Intended to ensure that development in a designated district meets the goals established in a Transit District Development Plan. Transit Districts may be designated in the vicinity of Metro stations to maximize transit ridership, serve the economic and social goals of the area, and take advantage of the unique development opportunities which mass transit provides.

D-D-O: Development District Overlay - Intended to ensure that development in a designated district meets the goals established in a Master Plan, Master Plan Amendment or Sector Plan. Development Districts may be designated for town centers, Metro areas, commercial corridors, employment centers, revitalization areas, historic areas and other special areas as identified in approved plans.

Water and Sewer Categories Used in this Report

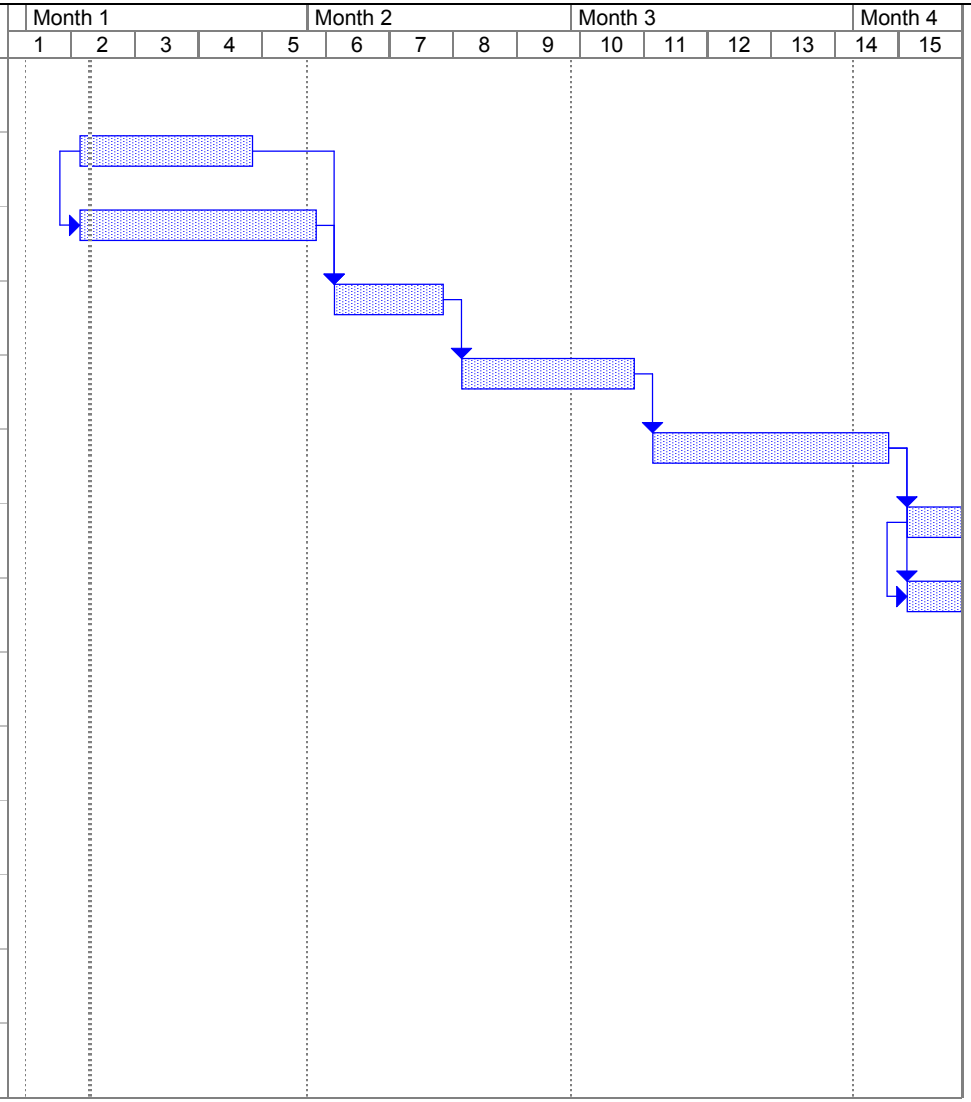
W-3 and S-3: Category 3-Community System – Developed land on public water and sewer, and undeveloped land with a valid preliminary plan approved for public water and sewer. The expiration of a preliminary plan will reverse the designation to Category 4 even if the maps have not been amended to reflect the change.

W-6 and S-6: Category 6-Individual Systems – Areas outside the limit of planned water and sewer service and certain larger tracts of parkland and open space. Development in Category 6 must use permanent individual water supply and wastewater disposal systems or shared facilities and smaller community systems as approved by the county. Redesignation to and from Category 6 must proceed through legislative amendment process.

APPENDIX X:

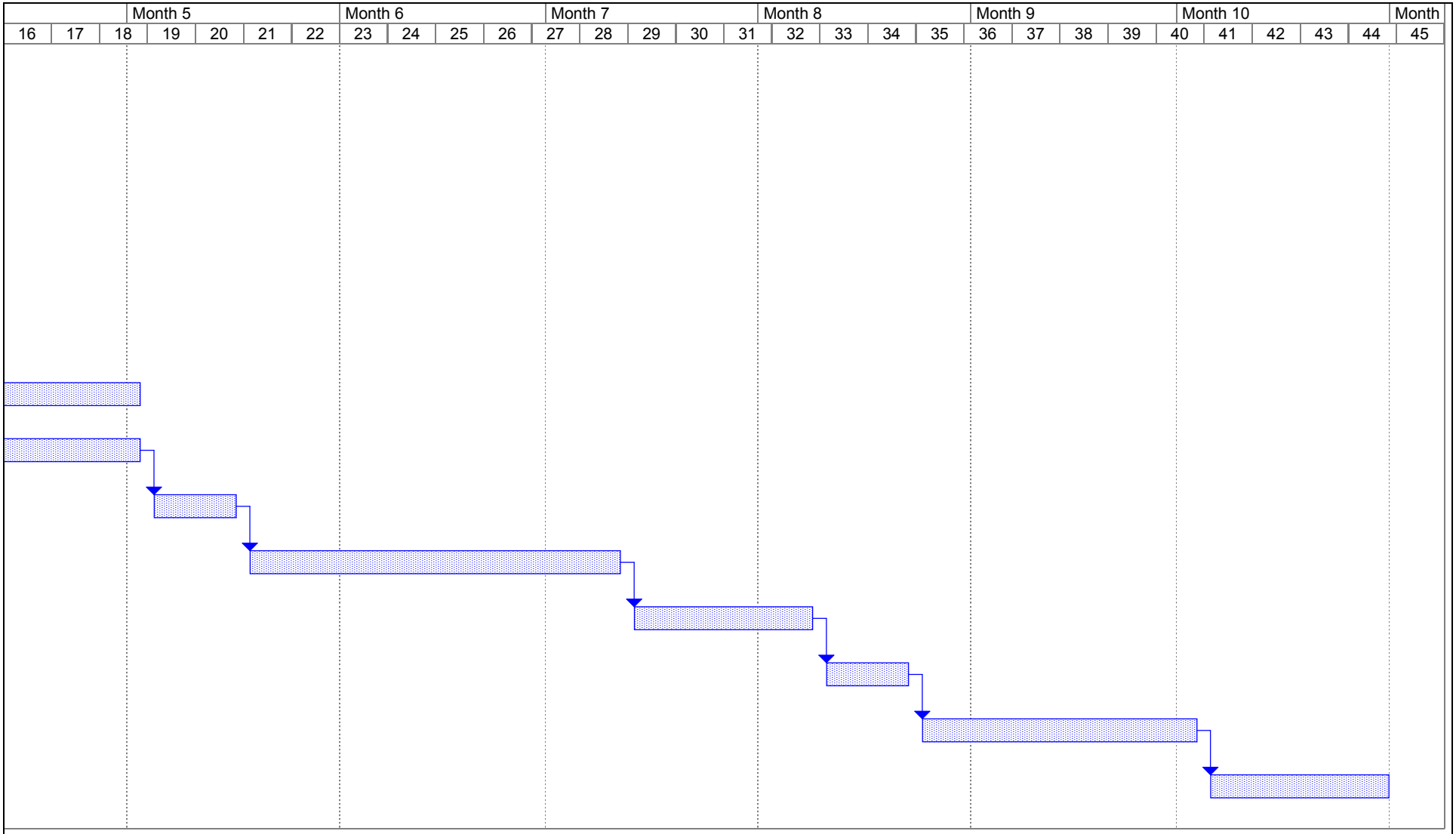
Implementation Flow Charts for the BRDC Project Plan and Accelerator Plan

ID	Task Name	Duration
1		
2	Select members of Project Implementation Committee	15 days
3	Defiine executive resource	20 days
4	Invite Chairman of Project Implementation Committee	10 days
5	Invite Project Implementation Committee members	15 days
6	Convene Project Implementation Committee	20 days
7	Agree Developer Selection Criteria	20 days
8	Research potential developers	20 days
9	Prepare public notice for RFI	10 days
10	Issue RFI for developers	40 days
11	Interview Developers	20 days
12	Select Preferred Developer	10 days
13	Negotiation with Preferred Developer	30 days
14	Development Contract Agreed	20 days



Project: MNCPP Project Plan v04 08J
Date: Tue 1/8/08

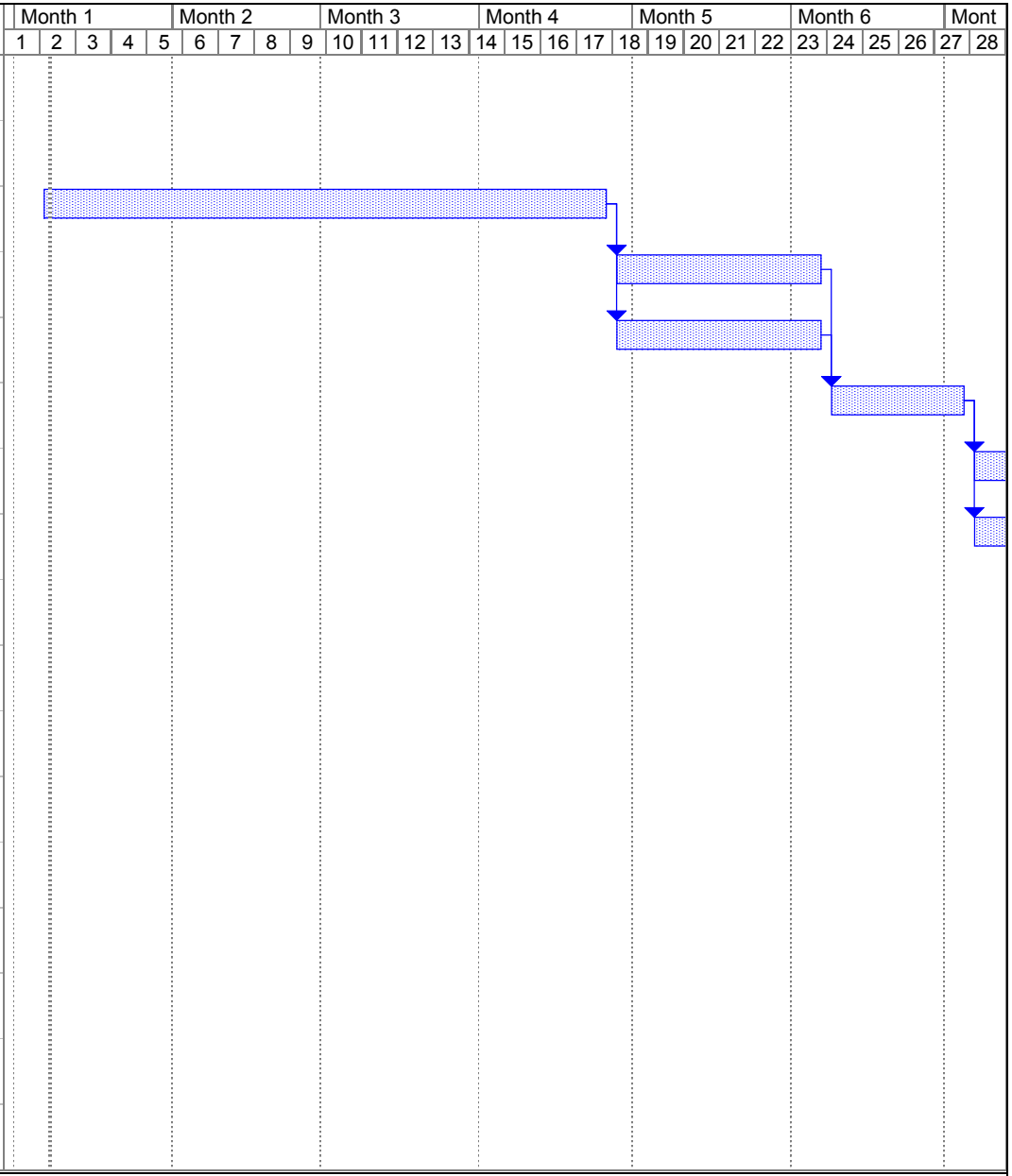
Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline



Project: MNCPP Project Plan v04 08J
Date: Tue 1/8/08

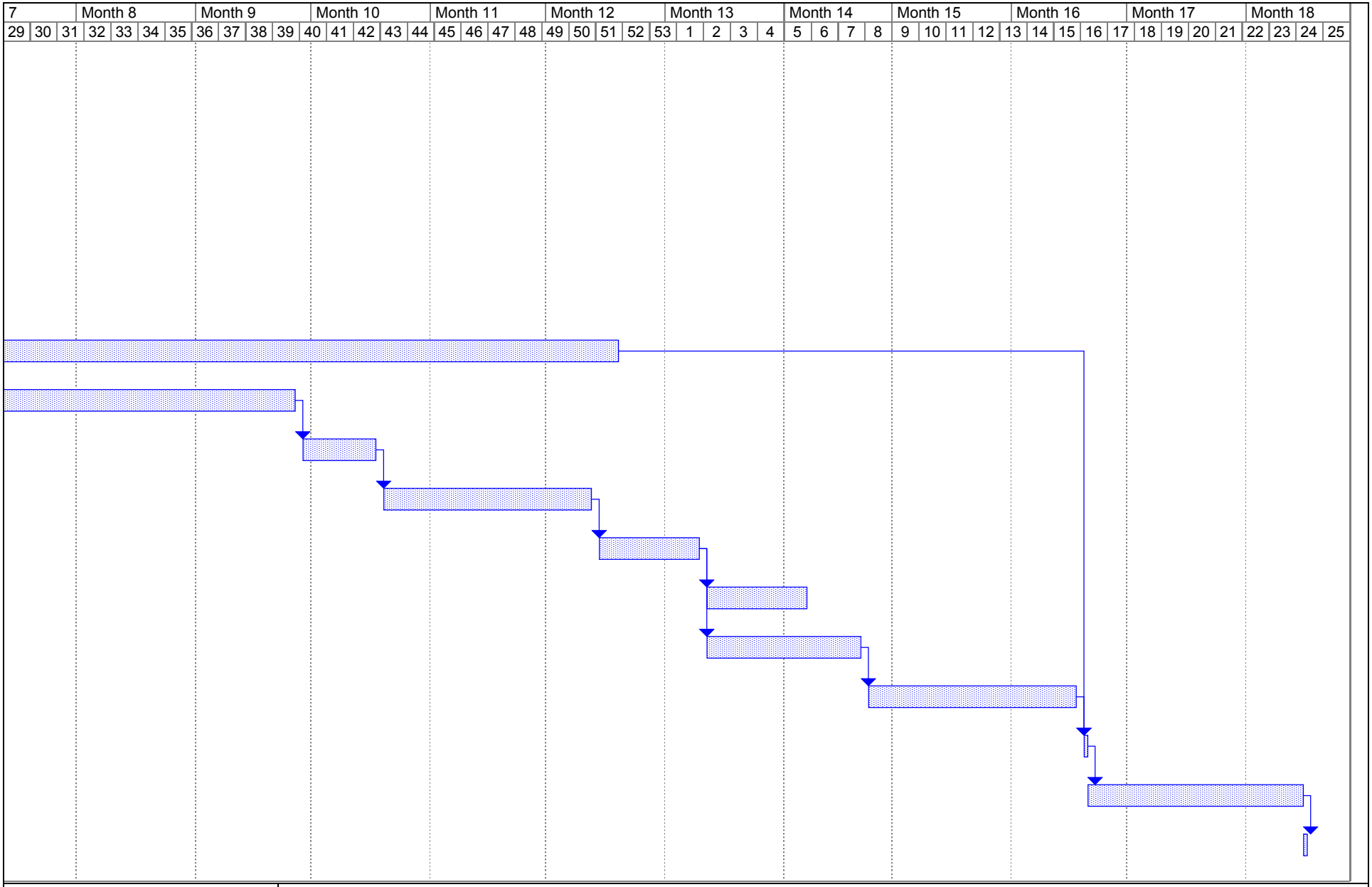
Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

ID	Task Name	Duration
1		
2		
3	Undertake Accelerator Feasibility Study for Public Sector Funding	80 days
4	Create Initial Accelerator Marketing Plan	30 days
5	Create Draft Operational Plan	30 days
6	Agree Operational Requirements with Developer	20 days
7	Implement Initial Accelerator Marketing Plan	120 days
8	Develop Detailed Operational Plan	60 days
9	Develop Incubation Program Staff Specs	15 days
10	Recruit Accelerator Program Manager	40 days
11	Refine Accelerator Marketing Plan	20 days
12	Confirm Operational Requirements with Developer	20 days
13	Plan Accelerator Fit-out	30 days
14	Undertake Fit-out	40 days
15	Open for first tenant	1 day?
16	Plan official launch event	40 days
17	Hold Launch Event	1 day?



Project: MNCPP Accelerator Project F
Date: Tue 1/8/08

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline



Project: MNCPP Accelerator Project F
Date: Tue 1/8/08

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	