



May 2, 2018

Mr. Troy E. Brestel
Project Engineer
DelDOT Division of Planning
P.O. Box 778
Dover, DE 19903

RE: Agreement No. 1773
Traffic Impact Study Services
Task No. 1A Subtask 7A – Cavaliers Development

Dear Mr. Brestel:

McCormick Taylor has completed its review of the Traffic Impact Study (TIS) for the Cavaliers Development prepared by McMahon Associates, Inc., dated November 14, 2017. McMahon prepared the report in a manner generally consistent with DelDOT's *Development Coordination Manual* [formerly *Standards and Regulations for Subdivision Streets*, incorporated by reference into the New Castle County Unified Development Code 40.11.130].

The TIS evaluates the impacts of the Cavaliers Development, proposed to be located along the south side of Churchmans Road (Delaware Route 58), east of I-95 and north of the Christiana Mall in New Castle County, Delaware. The proposed development would include 159 single-family homes, 288 apartments, 68 townhomes, 203 age-restricted detached homes, and a 44,460 SF banquet facility. It is noted that a portion of the proposed land use assumed in the TIS (203 age-restricted detached homes) is different than presented at the TIS Scoping Meeting, when it was proposed as 103 age-restricted detached homes and 100 age-restricted *attached* homes. The proposed development would replace the existing Cavaliers Country Club and golf course.

One full-movement access is proposed on Churchmans Road via the existing signalized intersection at Cavaliers Country Club Drive. Construction is anticipated to be complete by 2021.

The proposed development would be built on five parcels that are currently zoned as either Suburban (S) or Neighborhood Conservation 6.5 (NC 6.5) within New Castle County. The developer has proposed to rezone the site to Suburban Transition (ST) and Commercial, Regional (CR).

Regarding nearby relevant projects, the TIS identified a DelDOT Highway Safety Improvement Project (HSIP) along Churchmans Road from the Christiana Hospital to the DE Route 1 Southbound Ramps. According to the TIS, this project would restripe eastbound Churchmans Road to provide a shared through/right-turn lane to DE Route 1 southbound (i.e. add a third right-turn lane for this movement). The project would also restripe the outside southbound DE Route 1 off-ramp through lane to provide a shared through/right-turn lane to westbound Churchmans Road (i.e. add a second right-turn lane for this movement). However, some of the



HSIP project information provided and evaluated in the TIS was determined to be outdated. In particular, during a field investigation in December 2017, McCormick Taylor noted that reconstruction of the southbound off-ramp has already been completed under State Contract No. T200800702. The ramp is now configured with an exclusive left-turn lane, a shared left-turn/through lane, an exclusive through lane, and an exclusive right-turn lane (without channelization). This is similar to the existing conditions that were analyzed in the TIS, except that the right-turn lane is not channelized and does not flow into a lane-add condition on westbound Churchmans Road. McCormick Taylor coded this updated geometry for all existing and future cases.

Based on these findings and coordination with Darren O'Neill (DeIDOT Project Manager) in December 2017, it was determined that the HSIP project construction is complete and no further work is currently planned for either the southbound off-ramp approach or the eastbound Churchmans Road approach. As such, McCormick Taylor did not modify any lane configurations at this intersection in the 2021 future analyses.

An additional DeIDOT project within the study area was brought to McCormick Taylor's attention during the TIS review. DeIDOT, JMT, and Jacobs Engineering are evaluating potential options to improve traffic flow on I-95 southbound between DE Route 141 (Exit 5) and Churchmans Road (Exit 4B). The potential improvements include various options of Hard Shoulder Running (HSR) on I-95 southbound along with various intersection modifications along Churchmans Road. In a Technical Memorandum dated November 21, 2017, JMT indicated that DeIDOT's preferred alternative includes partial or full HSR on I-95 southbound, addition of one right-turn lane to the off-ramp from Exit 4B to Churchmans Road, and signalization of the movement from the I-95 southbound off-ramp to westbound Churchmans Road. Construction of the off-ramp modification project is anticipated to occur by 2021. While the TIS did not include this project in their future analyses, McCormick Taylor conducted analyses in future years both with and without this project.

DeIDOT has also envisioned a potential future "Churchmans Road Connector" that would provide a direct connection between Churchmans Road and the Christiana Mall area, with the alignment of the connector roadway going through the Cavaliers Country Club site. While this potential future project is presently conceptual only, as part of the redevelopment of the Cavaliers Country Club property, the developer will construct a significant portion of the new roadway, thus helping to facilitate DeIDOT's vision of a completed connection in the future.

Based on our review, we have the following comments and recommendations:

The proposed Cavaliers development would meet the New Castle County Level of Service (LOS) Standards as stated in Section 40.11.210 of the Unified Development Code (UDC), for all intersections included in the New Castle County scope of study.

However, as shown in the table below, based on the criteria listed in Chapter 2 of DeIDOT's *Development Coordination Manual*, three intersections identified by DeIDOT as being required

for study would exhibit LOS deficiencies without the implementation of physical roadway and/or traffic control improvements. These include one signalized intersection that was not part of New Castle County’s scope of study, and the stop-controlled minor street approaches at two unsignalized intersections. Because the unsignalized intersections are controlled by stop signs only on the minor street approaches, the deficiencies pertain to those approaches only, and the intersections are not subject to New Castle County’s concurrency requirements.

<i>Intersection</i>	<i>Existing Traffic Control</i>	<i>Situations for which deficiencies occur</i>
Churchmans Road & DE Route 1 SB Ramps	Signalized	2017 Existing PM (Case 1); 2021 without Cavaliers development PM (Case 2); 2021 with Cavaliers development PM (Case 3)
Churchmans Road & Addison Drive	Unsignalized	2021 without Cavaliers development AM & PM (Case 2); 2021 with Cavaliers development AM & PM (Case 3)
Churchmans Road & Artesian Driveway	Unsignalized	2017 Existing AM (Case 1); 2021 without Cavaliers development AM & PM (Case 2); 2021 with Cavaliers development AM & PM (Case 3)

The signalized intersection of Churchmans Road and DE Route 1 Southbound Ramps exhibits existing and future operational deficiencies, operating at LOS E during the existing PM peak hour and LOS F during the future PM peak hour. As noted, this intersection is not part of New Castle County’s scope of study for the TIS. The LOS deficiencies are attributed in part to the high traffic volumes traveling through this intersection to access both DE Route 1 southbound and I-95. This intersection had previously been identified as a DeIDOT Highway Safety Improvement Project (HSIP) location, with plans to add a third eastbound right-turn lane to provide additional capacity for this high-volume movement in the PM peak hour. However, significant issues with right-of-way and utilities were discovered, and the project changed such that limited improvements were recently constructed on the southbound approach and along westbound Churchmans Road. The envisioned eastbound improvements and other elements of the original concept for this project are no longer planned for construction in the foreseeable future. As DeIDOT has recently completed construction of the intersection improvement project and has already identified significant issues with potential additional improvements, we do not recommend any further improvements be made to this intersection by the developer. That said, as the Cavaliers development is constructed, traffic signal timings at this intersection should be re-evaluated and optimized to alleviate problematic delays and/or queues to the extent possible.

The unsignalized intersection of Churchmans Road and Addison Drive exhibits LOS deficiencies during future conditions, both without and with the Cavaliers development. The stop-controlled northbound Addison Drive approach is expected to operate at LOS E in the AM peak hour and LOS F in the PM peak hour. Since the AM peak hour approach volume is less than ten vehicles per hour, this LOS deficiency is considered negligible and mitigation would not be required. The PM peak hour approach volume is eleven (11) vehicles per hour, and the 95th

percentile queue length is expected to be less than one vehicle in length. Therefore, additional mitigation does not appear to be warranted. We do not recommend any further improvements be made to this intersection by the developer beyond those proposed in the TIS (which consist of lengthening the westbound Churchmans Road left-turn lane at Cavaliers Country Club Drive to extend through the Addison Drive intersection for a short distance to be determined, and possibly converting the portion east of Addison Drive to a center left-turn lane). We do, however, recommend that consideration be given to providing for a connection from the south end of Addison Drive into the subject development such that Addison Drive residents could use the signal at Cavaliers Country Club Drive to access Churchmans Road.

The unsignalized intersection of Churchmans Road and Artesian Driveway exhibits LOS deficiencies during existing and future conditions. The stop-controlled southbound approach of Artesian Driveway (a private driveway) operates at LOS E during the existing AM peak hour and is expected to operate at LOS F during the future AM and PM peak hours. The future with development 95th percentile queue length in both peak hours on this approach is expected to be less than three vehicles in length. A potential solution to the LOS deficiencies may be to signalize the Artesian Driveway by realigning and incorporating it into the existing nearby traffic signal on Churchmans Road at Gooding Drive. However, that potential mitigation may not be feasible as it would have major property and utility impacts, it might not meet traffic signal warrants, and it appears to be outside the scope of improvements that should be required by the Cavaliers residential development. Given that the Artesian Driveway is a private driveway with relatively short queue lengths, and signalization appears to have significant challenges, we do not recommend any improvements be made to this intersection.

Should the County choose to approve the proposed development, the following items should be incorporated into the site design and reflected on the record plan by note or illustration. All applicable agreements (i.e. letter agreements for off-site improvements and traffic signal agreements) should be executed prior to entrance plan approval for the proposed development.

1. The developer should provide a bituminous concrete overlay to Churchmans Road at DeIDOT's discretion, sufficient to address the areas affected by necessary striping and pavement marking changes in the vicinity of Cavaliers Country Club Drive. DeIDOT should analyze the existing lanes' pavement section and recommend an overlay thickness to the developer's engineer if necessary. The developer should coordinate with DeIDOT's Development Coordination Section during the site plan review process to determine limits of the overlay along with design and implementation responsibilities and other details for this overlay.

2. The developer should improve the intersection of Churchmans Road and Cavaliers Country Club Drive, which will serve as the site entrance for the proposed development. The proposed configuration is shown in the table below.

Approach	Current Configuration	Proposed Configuration
Eastbound Churchmans Road	One through lane and one right-turn lane	One through lane and one right-turn lane (channelized)
Westbound Churchmans Road	One left-turn lane and one through lane	One left-turn lane and one through lane
Northbound Cavaliers Country Club Drive	One left-turn lane and one right-turn lane	Two left-turn lanes and one right-turn lane (channelized)

To accommodate the dual northbound left-turn lanes, the developer will also need to provide a second westbound travel lane on Churchmans Road that will run from Cavaliers Country Club Drive to the I-95 southbound off-ramp intersection.

The developer should coordinate with DelDOT regarding the design and length of the westbound Churchmans Road left-turn lane at Cavaliers Country Club Drive, as it relates to the adjacent intersection of Addison Drive. As shown in the initial turn-length table below, the minimum turn-lane length for that westbound left-turn lane should be 150 feet (excluding taper), which reaches a point just to the west of the Addison Drive intersection. As left turns are also allowed from westbound Churchmans Road onto Addison Drive (which does not presently have a left-turn lane), the westbound left-turn lane for Churchmans Road should be extended through the Addison Drive intersection at DelDOT’s discretion (to be determined during the site plan review stage). This turn lane may be extended to the east at a distance to be determined, either as a dedicated westbound left-turn lane to serve both Addison Drive and Cavaliers Country Club Drive, or as a center left-turn lane east of Addison Drive given the existence of private driveways on the north side of Churchmans Road in that area.

Initial recommended minimum turn-lane lengths (excluding tapers) of the separate turn lanes are listed below. The developer should coordinate with DelDOT’s Development Coordination Section to determine final design details, including final turn-lane lengths, signing/striping/pavement markings and multi-modal design elements, during the site plan review process. Development of an acceptable concept plan for the Churchmans Road improvements and a record plan note requiring its implementation should be required prior to issuance of the Letter of No Objection to Recordation.

Approach	Left-Turn Lane(s)	Right-Turn Lane
Eastbound Churchmans Road	N/A	290 feet *
Westbound Churchmans Road	150 feet **	N/A
Northbound Cavaliers Country Club Drive	250 feet ***	N/A

* initial turn lane length based on DelDOT’s *Auxiliary Lane Worksheet*.

** initial turn-lane length based on storage length per queuing analysis, but as noted above the turn-lane length table, this may be extended further to the east through the Addison Drive intersection at DelDOT’s discretion.

*** initial turn lane length for second left-turn lane based on storage length per queuing analysis

3. The developer should enter into a traffic signal agreement with DelDOT for the intersection of Churchmans Road and Cavaliers Country Club Drive. The agreement will cover signal adjustments required by the physical improvements described in Item No. 2. The agreement should include pedestrian signals, crosswalks, interconnection, and ITS equipment such as CCTV cameras at DelDOT’s discretion. The developer should coordinate with DelDOT on the design details and implementation of the traffic signal modifications.
4. The developer should reconstruct Cavaliers Country Club Drive from Churchmans Road through the site to the southern property line, with two travel lanes in each direction and center median with left-turn lanes at internal intersections as appropriate. This roadway will also serve as a piece of the potential future “Churchmans Road Connector” that DelDOT has envisioned to provide a direct connection between Churchmans Road and the Christiana Mall area. The developer should coordinate with DelDOT’s Development Coordination Section during the site plan review process to determine the roadway design details.
5. The developer should provide sufficient right-of-way at the south end of the site to facilitate a possible future extension of Cavaliers Country Club Drive as a roadway interconnection to the Christiana Mall / Christiana Fashion Center shopping area located immediately to the south. This would allow for a connecting roadway (i.e., “Churchmans Road Connector”) to be built at some point in the future, at DelDOT’s discretion. The developer should coordinate with DelDOT’s Development Coordination Section to determine details for this right-of-way provision.
6. The following bicycle, pedestrian, and transit improvements should be included:
 - a. Appropriate bicycle symbols, directional arrows, striping (including stop bars), and signing should be included along bicycle facilities within the project limits.
 - b. If a clubhouse or other community facility is constructed as shown on the conceptual site plan, bike parking should be provided near the building entrances. Where the

- building architecture provides for an awning or other overhang, the bike parking should be covered.
- c. Utility covers should be made flush with the pavement.
 - d. Where sidewalk exists along Churchmans Road, the developer will be required to reconstruct the sidewalk (with a ten-foot width) and curb wherever the existing facilities will be removed for construction. The limits of the sidewalk widening would be from Cavaliers Country Club Drive to the point where the existing sidewalk narrows near the guardrail the connects to the barrier along the bridge over I-95; a distance of approximately 325 feet. With adding the two left-turn lanes out of the site, the shoulder along westbound Churchmans Road will be eliminated at this section. Bicyclists and pedestrians would have to cross the road at the crosswalk and utilize the sidewalk along eastbound Churchmans Road; the sidewalk needs to be wide enough to accommodate this additional usage. The curb ramps and crosswalks at the site entrance must be ADA compliant.
 - e. A minimum 10-foot wide permanent easement from the edge of the right-of-way should be dedicated to DelDOT throughout the entirety of the site along Cavaliers Country Club Drive. The outermost 2 feet of this easement width must be beyond the outer edge of the planned shared-use path. The developer should continue to coordinate with DelDOT's Development Coordination Section to finalize details of the easement.
 - f. Along both sides of Cavaliers Country Club Drive from Churchmans Road to the southern property line, and along both sides of the internal east-west oriented "Road A" that connects Cavaliers Country Club Drive with the apartment buildings in the western portion of the site, eight-foot wide shared-use paths that meet current AASHTO, ADA, and DelDOT standards should be constructed. The paths should have a minimum of an eight-foot buffer from the roadway. The paths should connect to the existing and/or proposed bicycle/pedestrian facilities at the intersection of Churchmans Road and Cavaliers Country Club Drive. The developer should coordinate with DelDOT's Development Coordination Section to determine details of the shared-use paths including connections at Churchmans Road and the southern property boundary.
 - g. In addition to the shared-use paths along Cavaliers Country Club Drive and "Road A" as described above, a network of shared-use paths should be constructed throughout the site. The developer should coordinate with DelDOT's Development Coordination Section during the site plan review process to determine design details of the shared-use paths including exact alignments and possible connections to surrounding properties.
 - h. Internal sidewalks for pedestrian safety and to promote walking as a viable transportation alternative should be constructed along subdivision streets within the development. These sidewalks should each be a minimum of five feet wide (with a minimum of a five-foot buffer from the roadway, except that the buffer needs to be a minimum of eight feet wide where there are trees or other objects placed within the buffer requiring additional width) and should meet current UDC, DelDOT, AASHTO

- and ADA standards. These internal sidewalks should connect to pedestrian facilities along Cavaliers Country Club Drive and Churchmans Road.
- i. ADA compliant curb ramps and crosswalks should be provided at all pedestrian crossings, including all site entrances and internal intersections. Type 3 curb ramps are discouraged.
 - j. Where internal sidewalks are located alongside of perpendicular or angled parking spaces, a buffer should be added to eliminate vehicular overhang onto the sidewalk.
 - k. The developer should coordinate with DTC to determine if additional transit stop amenities (e.g. shelters, benches, lighting) should be provided for the DART Route 15 stops at the intersection of Churchmans Road and Cavaliers Country Club Drive. In addition, the existing bus stop along eastbound Churchmans Road just to the west of Cavaliers Country Club Drive could potentially be relocated as part of the reconstruction of the intersection. The developer should coordinate this with DTC and DelDOT.
 - l. The developer should coordinate with DTC and DelDOT regarding potential inclusion of bus stops with amenities to be placed along Cavaliers Country Club Drive, which would be necessary to serve new/modified transit routes should the roadway be extended through to the Christiana Mall area in the future as envisioned. Bus stops would likely be spaced 1,000 feet to 1,250 feet apart.

Improvements in this TIS may be considered “significant” under DelDOT’s *Work Zone Safety and Mobility Procedures and Guidelines*. These guidelines are available on DelDOT’s website at http://deldot.gov/Publications/manuals/de_mutcd/index.shtml.

Please note that this review generally focuses on capacity and level of service issues; additional safety and operational issues will be further addressed through DelDOT’s subdivision review process.

Additional details on our review of this TIS are attached. Please contact me at (610) 640-3500 or through e-mail at ajparker@mccormicktaylor.com if you have any questions concerning this review.

Sincerely,
McCormick Taylor, Inc.

A handwritten signature in black ink, appearing to read "Andrew J. Parker".

Andrew J. Parker, P.E., PTOE
Project Manager

Enclosure

General Information

Report date: November 14, 2017

Prepared by: McMahon Associates, Inc.

Prepared for: Carlino Development Group

Tax parcel: 09-024.00-013, 09-025.00-008,009,010 & 011

Generally consistent with DelDOT's *Development Coordination Manual*: Yes

Project Description and Background

Description: The proposed development would include 159 single-family homes, 288 apartments, 68 townhomes, 203 age-restricted detached homes, and a 44,460 SF banquet facility. The proposed development would replace the existing Cavaliers Country Club and golf course.

Location: The Cavaliers Development is proposed to be located along the south side of Churchmans Road (Delaware Route 58), east of I-95 and north of the Christiana Mall in New Castle County, Delaware. A site location map is included on page 10.

Amount of land to be developed: Approximately 87 acres of a 146 acre assemblage of parcels would be developed, and 59 acres would be preserved as open space.

Land use approval(s) needed: Subdivision and rezoning approval. The proposed development would be built on five parcels that are currently zoned as either Suburban (S) or Neighborhood Conservation 6.5 (NC 6.5) within New Castle County. The developer has proposed to rezone the site to Suburban Transition (ST) and Commercial, Regional (CR).

Proposed completion date: 2021

Proposed access locations: One full-movement access is proposed on Churchmans Road via the existing signalized intersection at Cavaliers Country Club Drive.

Average Annual Daily Traffic Volumes (per DelDOT Traffic Summary 2016):

- 2016 Average Annual Daily Traffic on Churchmans Road: 19,554



2015 Delaware Strategies for State Policies and Spending

Location with respect to the Strategies for State Policies and Spending Map of Delaware:

The majority of the proposed Cavaliers Development is located within Investment Level 1 areas. However, portions of the parcels included in the development are within Investment Level 2 and Out of Play areas.

Investment Level 1

Areas of the state designated as Investment Level 1 are most prepared for growth and are where the state can make cost-effective infrastructure investments in schools, roads, and public safety. In these areas, state investments and policies should support and encourage a wide range of uses and densities, promote a variety of transportation options, foster efficient use of existing public and private investments, and enhance community identity and integrity. Investment Level 1 areas are often municipalities, towns, or urban/urbanizing places. Density is generally higher than in the surrounding areas. Overall, it is the state's intent to use its spending and management tools to maintain and enhance community character, to promote well-designed and efficient new growth, and to facilitate redevelopment in Investment Level 1 Areas.

Investment Level 2

Investment Level 2 has many diverse characteristics. These areas can be composed of less developed areas within municipalities, rapidly growing areas in the counties that have or will have public water and wastewater services and utilities, areas that are generally adjacent to or near Investment Level 1 areas, smaller towns and rural villages that should grow consistently with their historic character, and suburban areas with public water, wastewater, and utility services. These areas have been shown to be the most active portion of Delaware's developed landscape. They serve as transition areas between Level 1 and the state's more open, less populated areas. They generally contain a limited variety of housing types, predominantly detached single-family dwellings.

In Investment Level 2 areas, state investments and policies should support and encourage a wide range of uses and densities, promote other transportation options, foster efficient use of existing public and private investments, and enhance community identity and integrity.

Investments should encourage departure from the typical single-family-dwelling developments and promote a broader mix of housing types and commercial sites encouraging compact, mixed-use development where applicable. Overall, the State's intent is to use its spending and management tools to promote well-designed development in these areas. Such development provides for a variety of housing types, user-friendly transportation systems, and provides essential open spaces and recreational facilities, other public facilities, and services to promote a sense of community.

Out of Play

The 2015 Delaware Strategies for State Policies and Spending map indicates Out of Play areas adjacent to the Christina River. These areas are not expected to be used for private development, typically due to serious legal or environmental constraints. The development of these sites should consider natural resources and the environment, emphasizing the protection of critical natural habitat, wildlife, and stormwater management/drainage areas.

Proposed Development's Compatibility with Strategies for State Policies and Spending:

The majority of the proposed Cavaliers Development is located within an Investment Level 1 area. However, some portions of the parcels are located in Investment Level 2 and Out of Play areas. The proposed development would replace the existing Cavaliers Country Club with 718 residential units. Nearby land uses primarily include medium density residential, retail/service businesses, office space, hotels, restaurants, educational facilities, and open space/natural areas.

The proposed development is generally consistent with neighboring land uses (especially the adjacent Cavalier Country Club Apartments) and the character of Investment Level 1 areas. The *Strategies for State Policies and Spending* document encourages making use of existing infrastructure through infill development and redevelopment of underutilized tracts in Investment Level 1 areas.

Similarly, the development is generally consistent with Investment Level 2 areas. The Cavaliers Development would provide a mix of housing types, make use of existing infrastructure, provide opportunities for residents to utilize public transit, and preserve some open/natural space.

Provided the design and location of the proposed buildings takes into account the Out of Play areas, the proposed development appears to generally comply with the policies stated in the 2015 "Strategies for State Policies and Spending."

Comprehensive Plan

New Castle County Comprehensive Plan:

(Source: New Castle County 2012 Comprehensive Plan)

The *2012 Comprehensive Plan* indicates that the proposed development is within the "Upper Christina" planning district. The Future Land Use Map indicates that the proposed development is located in an area that is designated as low density residential (1-3 dwelling units per acre).

The majority of the land (parcel 09-024.00-013, approximately 145 acres) is currently zoned as Suburban (S) in New Castle County. The remaining parcels (approximately 2 acres) are currently zoned as Neighborhood Conservation 6.5 (NC 6.5) in New Castle County. Based on the PLUS application for this development, the developer proposes to rezone the land to Suburban Transition (ST) and Commercial, Regional (CR).

According to Section 40.02.200 of the New Castle County Unified Development Code (UDC), characteristics of the existing and proposed zoning districts are as follows:

Suburban (S) – Existing Zoning

- Permits a wide range of residential uses.
- Permits moderate to high-density development and a full range of residential uses in a manner consistent with providing a high quality suburban character. Significant areas of open space and/or landscaping shall be provided to maintain the balance between green space and buildings that characterize suburban character.
- Used to in-fill tracts containing at least five acres or where New Castle County seeks to redevelop the area to suburban character.

Neighborhood Conservation 6.5 (NC 6.5) – Existing Zoning

- Protect residential character of existing neighborhoods or planned subdivisions that were or are being developed under previous zoning regulations.
- Permit minor in-fill consistent with the existing character.

Suburban Transition (ST) – Proposed Zoning

- Provides for high quality, moderately high-density development with a full range of residential and limited nonresidential uses.
- Provide a suburban transition character while encouraging pedestrian linkages in addition to automobile access.
- Accommodates a range of housing types (from small single-family to multi-family).
- This district has specific location requirements:
 - Located in the central core of the southern sewer service area as described more fully in Resolution 06-069 and adopted by County Council on March 28, 2006, or
 - Development proposes gross density of less than five dwelling units per acre, or
 - Development proposes gross density of five dwelling units per acre or more and has access to transit service within one-quarter mile or is within two miles of a park and ride facility.

Commercial, Regional (CR) – Proposed Zoning

- Provide for community and regional commercial services with a suburban transition character.
- Promotes circulation by walking and automobile within contiguous commercial or office areas.
- Encourages large commercial complexes rather than development strips. New areas to be zoned CR should be large and deep.
- Residential mixed-use is permitted, and transit facilities are required.

Proposed Development’s Compatibility with Comprehensive Plan:

The proposed Cavaliers Development is to be comprised of 159 single-family homes, 288 apartments, 68 townhomes, 203 senior detached homes, and a 44,460 SF banquet facility. Based on the site plan included in the development’s PLUS application, it appears that CR zoning is proposed for the area of the site that would contain the 44,460 SF banquet facility. The remainder of the site, which would contain the 718 residential units, is proposed for ST zoning. It appears that the proposed development is consistent with the proposed zoning designations.

The development is to include 718 residential units on approximately 146 acres of land. This equates to a gross density of approximately 4.9 dwelling units per acre. However, the Future Land Use Map included in the Comprehensive Plan indicates that only 1-3 dwelling units per acre are expected for this area. Based on this conflict with the Future Land Use Map, the development may require additional discussion and approval by New Castle County in order to proceed to construction.

Relevant Projects

Regarding nearby relevant projects, the TIS identified a DelDOT Highway Safety Improvement Project (HSIP) along Churchmans Road from the Christiana Hospital to the DE Route 1 Southbound Ramps. According to the TIS, this project would restripe eastbound Churchmans Road to provide a shared through/right-turn lane to DE Route 1 southbound (i.e. add a third right-turn lane for this movement). The project would also restripe the outside southbound DE Route 1 off-ramp through lane to provide a shared through/right-turn lane to westbound Churchmans Road (i.e. add a second right-turn lane for this movement). However, some of the HSIP project information provided and evaluated in the TIS was determined to be outdated. In particular, during a field investigation in December 2017, McCormick Taylor noted that reconstruction of the southbound off-ramp has already been completed under State Contract No. T200800702. The ramp is now configured with an exclusive left-turn lane, a shared left-turn/through lane, an exclusive through lane, and an exclusive right-turn lane (without channelization). This is similar to the existing conditions that were analyzed in the TIS, except that the right-turn lane is not channelized and does not flow into a lane-add condition on westbound Churchmans Road. McCormick Taylor coded this updated geometry for all existing and future cases.

Based on these findings and coordination with Darren O'Neill (DelDOT Project Manager) in December 2017, it was determined that the HSIP project construction is complete and no further work is currently planned for either the southbound off-ramp approach or the eastbound Churchmans Road approach. As such, McCormick Taylor did not modify any lane configurations at this intersection in the 2021 future analyses.

An additional DelDOT project within the study area was brought to McCormick Taylor's attention during the TIS review. DelDOT, JMT, and Jacobs Engineering are evaluating potential options to improve traffic flow on I-95 southbound between DE Route 141 (Exit 5) and Churchmans Road (Exit 4B). The potential improvements include various options of Hard Shoulder Running (HSR) on I-95 southbound along with various intersection modifications along Churchmans Road. In a Technical Memorandum dated November 21, 2017, JMT indicated that DelDOT's preferred alternative includes partial or full HSR on I-95 southbound, addition of one right-turn lane to the off-ramp from Exit 4B to Churchmans Road, and signalization of the movement from the I-95 southbound off-ramp to westbound Churchmans Road. Construction of the off-ramp modification project is anticipated to occur by 2021. While the TIS did not include this project in their future analyses, McCormick Taylor conducted analyses in future years both with and without this project.

DelDOT has also envisioned a potential future “Churchmans Road Connector” that would provide a direct connection between Churchmans Road and the Christiana Mall area, with the alignment of the connector roadway going through the Cavaliers Country Club site. While this potential future project is presently conceptual only, as part of the redevelopment of the Cavaliers Country Club property, the developer will construct a significant portion of the new roadway, thus helping to facilitate DelDOT’s vision of a completed connection in the future.

Trip Generation

Trip generation for the proposed development was computed using comparable land uses and equations contained in Trip Generation, Ninth Edition, published by the Institute of Transportation Engineers (ITE). The following land uses were utilized to estimate the amount of new traffic generated for this development:

- Proposed 288 open space planned apartments: ITE Land Use Code 220 (Apartment)
- Proposed 159 open space planned single-family village homes: ITE Land Use Code 210 (Single-Family Detached Housing)
- Proposed 68 open space planned townhomes: ITE Land Use Code 230 (Residential Condominium/Townhouse)
- Proposed 203 age restricted open space planned carriage homes, single family lot line homes, and single family twin homes: ITE Land Use Code 251 (Senior Adult Housing – Detached)
- Existing 18-hole golf course (trips to be removed): ITE Land Use Code 430 Golf Course for daily trips, existing traffic counts for AM and PM peak hour trips

Additional notes regarding the trip generation for the proposed development:

- Total vehicular trips were reduced by 4.4% to account for trips by walking, biking, and transit. This calculation was based on local data found within the Mode to Work Data by Census Tract from the 2006-2010 American Community Survey (provided by the Wilmington Area Planning Council).
- It is McCormick Taylor’s understanding that the 44,460 SF banquet facility was not included in the trip generation as this land use is likely to generate trips at times that do not regularly coincide with the weekday morning and afternoon traffic peaks on the adjacent roadway network.
- It is noted that the age-restricted portion of the proposed land use assumed in the TIS (203 age-restricted detached homes) is different than presented at the TIS Scoping Meeting, when it was proposed as 103 age-restricted detached homes and 100 age-restricted *attached* homes.

Table 1
CAVALIERS DEVELOPMENT PEAK HOUR TRIP GENERATION

Land Use	Weekday AM Peak Hour			Weekday PM Peak Hour		
	In	Out	Total	In	Out	Total
288 apartments (LU #220)	29	116	145	114	62	176
159 single-family homes (LU #210)	30	91	121	100	59	159
68 townhomes (LU #230)	6	32	38	29	15	44
203 age-restricted homes (LU #251)	22	42	64	46	30	76
<i>Transit/Pedestrian/Bicycle Reduction</i>	-3	-12	-15	-12	-8	-20
<i>18-hole golf course (to be removed)</i>	-19	-1	-20	-26	-17	-43
TOTAL "NEW" TRIPS	65	268	333	251	141	392

Table 2
CAVALIERS DEVELOPMENT TOTAL DAILY TRIP GENERATION

Land Use	Weekday ADT		
	In	Out	Total
288 apartments (LU #220)	935	935	1,870
159 single-family homes (LU #210)	805	805	1,610
68 townhomes (LU #230)	230	230	460
203 age-restricted homes (LU #251)	444	444	888
<i>Transit/Pedestrian/Bicycle Reduction</i>	-106	-106	-212
<i>18-hole golf course (to be removed)</i>	-322	-322	-644
TOTAL "NEW" TRIPS	1,986	1,986	3,972

Overview of TIS

Intersections examined (with agency scope of study requirements indicated):

Intersection	DeIDOT	New Castle County
1. Churchmans Road (DE Route 58) & DE Route 1 Southbound Ramps	X	
2. Churchmans Road & DE Route 7 Northbound Ramps / Geoffrey Drive	X	X
3. Churchmans Road & Del Tech Access / Geoffrey Drive	X	X
4. Churchmans Road & I-95 Southbound Off-Ramp	X	X
5. Churchmans Road & Cavaliers Country Club Drive	X	X
6. Churchmans Road & Addison Drive	X	X
7. Churchmans Road & Artesian Driveway	X	X
8. Churchmans Road & Gooding Drive	X	X
9. Churchmans Road & Airport Road (DE Route 37)	X	

Conditions examined:

- 1) 2017 existing
- 2) 2021 without Cavaliers Development
- 3) 2021 with Cavaliers Development

Peak hours evaluated: Weekday morning and evening peak hours

Committed developments considered:

- 1) Catawba Property (12,000 SF high-turnover sit-down restaurant, at 483 Stanton-Ogletown Road)
- 2) JP Morgan (606,634 SF office space and 129,000 SF commercial space, at 500 Stanton-Christiana Road)
- 3) Sallie Mae (41,554 SF office space, at 300 Continental Drive)
- 4) MBNA Westgate/Bank of America (977,018 SF office space, at 1201 Continental Drive)
- 5) Christiana Hospital (63,865 SF hospital, at 4755 Stanton-Christiana Road)
- 6) Marvel Plaza (200-seat high-turnover sit-down restaurant and 10,000 SF specialty retail, at 501 Stanton-Christiana Road)
- 7) SPCA Commerical (11,700 SF specialty retail, 5,371 SF convenience store with 20 fueling positions, and 4,000 SF fast-food restaurant with drive-thru, at 455 Stanton-Christiana Road)
- 8) Country Commerce Office Park (42,000 SF medical office, at 620 Churchmans Road)
- 9) Halko Property (28,550 SF warehouse, at 1 Halko Lane)
- 10) New Castle Town Center (476,248 SF commercial space, at the intersection of Christiana Road & Churchmans Road)

Intersection Descriptions

1) Churchmans Road (DE Route 58) & DE Route 1 Southbound Ramps

Type of Control: signalized

Southbound approach: (DE Route 1 SB off-ramp) one left-turn lane, one shared left-turn/thru lane, one thru lane, one right-turn lane

Eastbound Approach: (Churchmans Road / DE Route 58) three thru lanes, two channelized right-turn lanes

Westbound approach: (Churchmans Road / DE Route 58) two left turn lanes, three thru lanes

- 2) **Churchmans Road (DE Route 58) & DE Route 7 Northbound Ramps / Geoffrey Drive**
Type of Control: signalized
Southbound Approach: (DE Route 7 NB off-ramp) one left-turn lane, one shared left-turn/thru lane, one channelized right-turn lane
Eastbound Approach: (Churchmans Road / DE Route 58) two left-turn lanes, two thru lanes, one channelized right-turn lane
Westbound approach: (Churchmans Road / DE Route 58) one left-turn lane, three thru lanes, one channelized right-turn lane (for NB on-ramp well in advance of traffic signal)

- 3) **Churchmans Road (DE Route 58) & Del Tech Access / Geoffrey Drive**
Type of Control: signalized
Northbound approach: (Geoffrey Drive) one left-turn lane, one thru lane, one right-turn lane
Southbound Approach: (Del Tech Access) one left-turn lane, one right-turn lane
Eastbound Approach: (Churchmans Road / DE Route 58) one left-turn lane, two thru lanes, one channelized right-turn lane
Westbound approach: (Churchmans Road / DE Route 58) three thru lanes, one right-turn lane

- 4) **Churchmans Road (DE Route 58) & I-95 Southbound Off-Ramp**
Type of Control: signalized
Southbound approach: (I-95 SB Off-Ramp) existing one left-turn lane (signalized) and one channelized right-turn lane (unsignalized); DelDOT project proposes one left-turn lane (still signalized) and two right-turn lanes (to be signalized)
Eastbound approach: (Churchmans Road / DE Route 58) two thru lanes
Westbound approach: (Churchmans Road / DE Route 58) two thru lanes

- 5) **Churchmans Road (DE Route 58) & Cavaliers Country Club Drive**
Type of Control: signalized
Northbound approach: (Cavaliers Country Club Drive) existing one left-turn lane, one right-turn lane; proposed two left-turn lanes, one right-turn lane
Eastbound approach: (Churchmans Road / DE Route 58) one thru lane, one right-turn lane
Westbound approach: (Churchmans Road / DE Route 58) one left-turn lane, one thru lane

- 6) **Churchmans Road (DE Route 58) & Addison Drive**
Type of Control: unsignalized three-leg intersection (one-way stop)
Northbound approach: (Addison Drive) one shared left-turn/right-turn lane (stop-controlled)
Eastbound approach: (Churchmans Road / DE Route 58) one shared thru/right-turn lane
Westbound approach: (Churchmans Road / DE Route 58) existing one shared left-turn/thru lane; proposed one two-way center left-turn lane and one thru lane

- 7) **Churchmans Road (DE Route 58) & Artesian Driveway**
Type of Control: unsignalized three-leg intersection (one-way stop)
Southbound approach: (Artesian Driveway) one left-turn lane, one channelized right turn lane (stop-controlled)
Eastbound approach: (Churchmans Road / DE Route 58) one shared left-turn/thru lane, one bypass lane
Westbound approach: (Churchmans Road / DE Route 58) one shared thru/right-turn lane

- 8) **Churchmans Road (DE Route 58) & Gooding Drive**
Type of Control: signalized
Northbound approach: (Gooding Drive) one left-turn lane, one right-turn lane
Eastbound approach: (Churchmans Road / DE Route 58) one shared thru/right-turn lane
Westbound approach: (Churchmans Road / DE Route 58) one shared left-turn/thru lane

- 9) **Churchmans Road (DE Route 58) & Airport Road (DE Route 37)**
Type of Control: signalized
Northbound approach: (Airport Road / DE Route 37) two left-turn lanes, two thru lanes, one bicycle lane, one channelized right turn lane
Southbound approach: (Airport Road / DE Route 37) two left-turn lanes, two thru lanes, one bicycle lane, one channelized right turn lane
Eastbound approach: (Churchmans Road / DE Route 58) two left-turn lanes, two thru lanes, one bicycle lane, one channelized right turn lane
Westbound approach: (Churchmans Road / DE Route 58) one left-turn lane, two thru lanes, one channelized right turn lane

Safety Evaluation

Crash Data: Crash data was obtained for the Churchmans Road (DE Route 58) corridor between the intersection with DE Route 1 Southbound Ramps and the intersection with Airport Road (DE Route 37). The data covered a three-year period from 9/22/2014 through 9/22/2017 and included reportable crashes that occurred within a one-tenth mile radius of the Churchmans Road (DE Route 58) centerline.

There were 486 crashes included in the report generated by the Delaware Crash Analysis Reporting System (CARS). Of the 486 crashes, 142 were removed from the study because they occurred on grade-separated roadways (DE Route 1/DE Route 7 and I-95) that pass through the study area. These crashes occurred geographically within the boundary drawn in CARS, but were not related to operations on Churchmans Road (DE Route 58) or intersecting roadways.

Of the 344 remaining crashes included in this study, 74 (22%) resulted in personal injury. There were no fatal crashes reported. The primary manner of impact was front-to-rear (62%) followed by angle crashes (18%). There were two crashes involving a pedestrian or bicycle and both occurred west of I-95. Within the study area, 59 (17%) crashes were reported to have wet road conditions; 129 (38%) crashes were related to driver inattention, distraction, or fatigue; 28 (8%)

crashes were related to disregard for traffic signals; and 124 (36%) occurred during the hours of peak traffic volume (7:00am-9:00am and 4:00pm-6:00pm).

Automatic red light enforcement cameras are located at three intersections along the corridor. There were 28 crashes that were caused by disregard for traffic signals within the study area and of those, 19 (68%) occurred at intersections with automatic red light enforcement cameras.

- Churchmans Road (DE Route 58) & DE Route 1 Southbound Ramps
- Churchmans Road (DE Route 58) & DE Route 7 Northbound Ramps / Geoffrey Drive
- Churchmans Road (DE Route 58) & I-95 Southbound Off-Ramp

This evaluation will focus on the area immediately surrounding the proposed development including the signalized intersection of Churchmans Road (DE Route 58) & Cavaliers Country Club Drive and the stop-controlled intersection of Churchmans Road (DE Route 58) & Addison Drive. Within the focus area that includes both intersections, the most common crash type was front-to-rear (64%) followed by angle (20%). During the three-year period, there were 19 crashes at the Cavaliers Country Club Drive intersection and 6 crashes at the Addison Drive intersection. At the Cavaliers Country Club Drive intersection, twelve (12) crashes were front-to-rear and three (3) crashes were angle. At the Addison Drive intersection, four (4) crashes were front-to-rear and two (2) were angle. The crash narratives did not reveal any trends related to sight distance or available storage for vehicles making westbound left turns onto Addison Drive.

While reviewing the crash records and reading the crash narratives, there appears to be a trend in front-to-rear crashes along Churchmans Road (DE Route 58) in the eastbound direction. Between the intersection of Churchmans Road (DE Route 58) & Del Tech Access / Geoffrey Drive and the intersection of Churchmans Road (DE Route 58) & Cavaliers Country Club Drive, multiple narratives reported crashes that were consistent with situations where vehicles are making sudden stops and traffic congestion. Along this segment, Churchmans Road (DE Route 58) drops from two lanes to one lane in the eastbound direction. The actual lane drop is immediately east of the I-95 SB off-ramp. It is recommended that the developer and DelDOT investigate extending the second eastbound lane to the intersection at Cavaliers Country Club Drive and coordination of signal timings along the full length of the study area to facilitate progression along Churchmans Road (DE Route 58).

Note there is a difference between the number of crashes included in this safety evaluation compared to those summarized in the November 14, 2017 Traffic Impact Study. This difference is likely due to the level of accuracy in the CARS data, conflicting location data between crash narratives and CARS crash summary tables, and the subjective nature of classifying intersection crashes and midblock crashes.

Sight Distance: Sight distance appears to be adequate throughout the study area. No problematic sight distance issues have been reported or indicated by crash data, and no major problems were noted during field observations.

There is some vertical and horizontal curvature though the study area. Traveling eastbound along Churchmans Road (DE Route 58), there is a positive grade approaching the bridge over I-95 and

a negative grade continuing east towards Airport Road (DE Route 37). The most significant horizontal curvature is present between the Artesian Driveway and Airport Road (DE Route 37). Considering this geometry, there are few potential sight distance obstructions.

Transit, Pedestrian, and Bicycle Facilities

Existing transit service: The closest existing transit stops are located at the intersection of Churchmans Road (DE Route 58) & Cavaliers Country Club Drive. According to the DART Bus Stop Map, Route 15 serves these stops. Route 15 runs seven days a week and provides service between Downtown Wilmington and the Christiana Mall Park & Ride. The stops at this location currently have large concrete waiting pads adjacent to sidewalk and crosswalks. However, no additional transit amenities (e.g. shelters or benches) are provided.

Planned transit service: McCormick Taylor contacted the Delaware Transit Corporation (DTC) regarding planned transit service via email on December 1, 2017. Mr. David Dooley responded and stated that if the connector road is extended through to the Christiana Mall, DTC would call for bus stops with amenities to be placed along that roadway in both the inbound and outbound directions. Bus stops would likely be spaced 1,000 feet to 1,250 feet apart.

Particularly since vehicular trip reductions were assumed for transit trips, the developer should coordinate with DTC to determine if additional transit stop amenities (e.g. shelters, benches, lighting) should be provided for the DART Route 15 bus stops at the intersection of Churchmans Road (DE Route 58) & Cavaliers Country Club Drive.

Existing bicycle and pedestrian facilities: Based on the *New Castle County Bicycle Map* published by DelDOT in 2011, Churchmans Road (DE Route 58) is classified as a “connector bicycle route with bikeway (high traffic)” throughout the study area. The portion of Churchmans Road (DE Route 58) from approximately Continental Drive to the I-95 southbound off-ramp is labeled as “challenging for cyclists.” The East Coast Greenway (ECG) route also runs along Churchmans Road (DE Route 58) throughout the study area. The ECG map indicates that the bikeway runs along a trail on the south side of Churchmans Road (DE Route 58) from Ogleton-Stanton Road to Cavaliers Country Club Drive. This suggests that bicyclists should ride on the sidewalk in this area, which is likely how most cyclists would choose to travel through this area. Continuing east, the bikeway is then shown as an “on road” facility until reaching King Court, which likely refers to the wide shoulders provided in this area. From King Court to Airport Road (DE Route 37), the bikeway is shown as a trail along the north side of Churchmans Road (DE Route 58). A paved multi-use path is provided in this area. On road bicycle lanes are provided between the thru and right-turn lanes on the northbound, southbound, and eastbound approaches at the intersection of Churchmans Road (DE Route 58) & Airport Road (DE Route 37) to help cyclists travel through this intersection.

Several other roadways within the study area are also identified as bicycle routes on the New Castle County Bicycle Map. DE Route 7 north of Churchmans Road (DE Route 58) is classified as a “connector bicycle route with bikeway (high traffic).” Airport Road (DE Route 37) south of Churchmans Road (DE Route 58) is classified as a “connector bicycle route with bikeway (high

traffic).” Airport Road (DE Route 37) north of Churchmans Road (DE Route 58) is shown as having a bikeway and high traffic volumes.

Within the study area, sidewalk is provided along the south side of Churchmans Road (DE Route 58) from the DE Route 1 southbound ramps to Cavaliers Country Club Drive. Between Cavaliers Country Club Drive and approximately Kings Court, no exclusive pedestrian facilities are present. At the intersection of Churchmans Road (DE Route 58) & Airport Road (DE Route 37), either sidewalk or multi-use path is provided along all quadrants of the intersection. A summary of pedestrian facilities by intersection is provided below.

1. Churchmans Road (DE Route 58) & DE Route 1 Southbound Ramps

Crosswalks and pedestrian signals are provided to cross the western leg of the intersection; a pedestrian refuge area is provided in the median. Crosswalks are provided to cross the southern leg of the intersection, but pedestrian signals are not provided.

2. Churchmans Road (DE Route 58) & DE Route 7 Northbound Ramps / Geoffrey Drive

A crosswalk is provided to cross the southern leg of the intersection, but pedestrian signals are not provided.

3. Churchmans Road (DE Route 58) & Del Tech Access / Geoffrey Drive

Crosswalks with pedestrian signals are provided to cross the eastern and southern legs of the intersection.

4. Churchmans Road (DE Route 58) & I-95 Southbound Off-Ramp

No pedestrian crossings are provided. The sidewalk along the south side of Churchmans Road (DE Route 58) is separated from the roadway by concrete barrier.

5. Churchmans Road (DE Route 58) & Country Club Drive

Crosswalks with pedestrian signals are provided to cross the eastern and southern legs of the intersection.

6. Churchmans Road (DE Route 58) & Addison Drive

No pedestrian crossings are provided.

7. Churchmans Road (DE Route 58) & Artesian Driveway

No pedestrian crossings are provided.

8. Churchmans Road (DE Route 58) & Gooding Drive

No pedestrian crossings are provided.

9. Churchmans Road (DE Route 58) & Airport Road (DE Route 37)

Crosswalks with pedestrian signals are provided to cross all legs of the intersection.

Planned bicycle and pedestrian facilities: McCormick Taylor contacted DelDOT’s Statewide and Regional Planning Section to obtain input on pedestrian and bicycle facilities in the vicinity

of the proposed development. John Fiori provided a response via email on January 12, 2018 with the following comments:

- DelDOT does have planned bicycle/pedestrian facilities in this area. A shared-use path is proposed through this site and along Cavaliers Country Club Drive. This site shall incorporate a shared-use path/sidewalk from Parcel 0902400014 (Lands n/f of the State of Delaware) to the intersection of Churchmans Road that will connect to an existing facility.
- Recommend to incorporate an internal path for the residents.
- Sidewalk required along the internal subdivision streets.
- Provide the right-of-way/perpetual cross access easement to Parcel 0902400014 in order to make an interconnection in the future.
- All entrance, roadway and/or intersection improvements shall incorporate bicycle and pedestrian facilities.

Previous Comments

Most comments from DelDOT's Scoping Letter, Traffic Count Review, and Preliminary TIS (PTIS) Review appear to have been addressed in the Final TIS submission. However, although the TIS describes existing transit, pedestrian, and bicycle facilities, the future needs of these users are not specifically addressed. In addition, the TIS utilized outdated project information for the DelDOT HSIP on Churchmans Road (DE Route 58) between the Christiana Hospital and DE Route 1, which resulted in analysis of a configuration that is no longer planned.

General Capacity Analysis Comments

(see table footnotes on the following pages for specific comments)

- 1) The traffic signal timing charts included in the TIS were obtained in 2014 and 2015. These timings appear to be outdated at several study intersections. McCormick Taylor obtained updated traffic signal timing charts from DelDOT in December 2017 and utilized these timings in the analyses.
- 2) The TIS utilized HCS 2010 Methodology within Synchro 8.0 (build 806, rev. 77) for most analyses. McCormick Taylor utilized HCS 2010 Methodology within an updated version of Synchro software available at the time of the TIS review (Synchro 10.1, build 2, rev. 20).
- 3) HCS 2010 Methodology does not support analysis of the existing lane configuration and traffic signal phasing at the intersection of Churchmans Road (DE Route 58) & Gooding Drive (protected/permitted left-turn phasing without a separate left-turn lane on the westbound approach). Therefore, both the TIS and McCormick Taylor utilized Synchro results for that intersection.
- 4) HCS 2010 Methodology does not support analysis of the future lane configuration and traffic signal phasing at the intersection of Churchmans Road (DE Route 58) & I-95 SB off-ramp (with DelDOT's planned I-95 Off-Ramp Widening project). Therefore,

McCormick Taylor utilized Synchro results for analysis of future scenarios with the planned off-ramp modifications at that intersection.

- 5) As per the DelDOT Development Coordination Manual, both the TIS and McCormick Taylor used a base saturation flow rate of 1,900 pchpl for all analyses.
- 6) Both the TIS and McCormick Taylor assumed future heavy vehicle percentages to be the same as existing conditions.
- 7) Both the TIS and McCormick Taylor assumed future Peak Hour Factors (PHF) to be the same as existing conditions.
- 8) The TIS and McCormick Taylor used different cycle lengths and/or signal timing parameters when analyzing the signalized intersections in some cases.

Table 3
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ¹	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
1) Churchmans Road (DE Route 58) & DE Route 1 Southbound Ramps ²				
2017 Existing	B (18.4)	D (35.4)	B (16.8)	E (74.0)
2021 without Cavaliers Development	B (19.2)	D (47.6)	B (18.1)	F (114.9)
2021 without Cavaliers Development & with DelDOT Improvements ³	B (19.0)	C (28.0)	-	-
2021 with Cavaliers Development	B (19.9)	D (50.5)	B (18.7)	F (114.2)
2021 with Cavaliers Development & with DelDOT Improvements ³	B (19.7)	C (32.3)	-	-
2021 with Cavaliers Development <i>With Optimized Traffic Signal Splits</i>	-	-	-	E (74.9)

¹ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

² The existing roadway geometry coded in the TIS was found to be inconsistent with actual 2017 existing conditions. Based on McCormick Taylor's field investigation, the free-flow channelized right-turn has been removed from the southbound approach. This right-turn is no longer channelized and does not flow into a lane-add condition on Churchmans Road (DE Route 58). McCormick Taylor coded this updated geometry for all existing and future cases.

³ McCormick Taylor coordinated with Darren O'Neill (DelDOT Project Manager) in December 2017 regarding the status of the HSIP project between the Christiana Hospital and DE Route 1. Mr. O'Neill stated that the project is complete and no additional work is currently planned for either the southbound off-ramp approach or the eastbound Churchmans Road (DE Route 58) approach. Therefore, McCormick Taylor did not modify any lane configurations at this intersection in the 2021 future analyses.

Table 4
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ⁴	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
2) Churchmans Road (DE Route 58) & DE Route 7 NB Ramps / Geoffrey Drive ⁵				
2017 Existing	B (13.7)	B (11.9)	C (29.4)	A (7.0)
2021 without Cavaliers Development	B (14.9)	B (10.9)	C (29.2)	A (6.9)
2021 with Cavaliers Development	B (13.8)	B (10.3)	C (22.5)	A (6.4)

⁴ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁵ The southbound channelized right-turn is signal controlled and allows for right turns on red. The analysis in the TIS coded this control, but it is unclear how the number of right turns on red was determined; no separate counts of right turns on red are shown in the turning movement counts. Therefore, McCormick Taylor coded this movement as yield controlled, which is an approximation of how this approach actually operates.

Table 5
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahan Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ⁶	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
3) Churchmans Road (DE Route 58) & Del Tech Access / Geoffrey Drive				
2017 Existing	A (9.0)	C (24.1)	B (13.1)	A (9.8)
2021 without Cavaliers Development	A (8.4)	C (20.7)	B (13.5)	A (9.6)
2021 with Cavaliers Development	A (8.1)	C (20.8)	B (13.9)	A (9.4)

⁶ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

Table 6
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ⁷	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
4) Churchmans Road (DE Route 58) & I-95 SB Off-Ramp ⁸				
2017 Existing	A (4.3)	A (4.4)	A (5.5)	A (5.5)
2021 without Cavaliers Development	A (4.8)	A (4.4)	A (5.7)	A (5.6)
2021 without Cavaliers Development <i>With I-95 Off-Ramp Project</i> ⁹	-	-	D (40.9)	B (17.1)
2021 with Cavaliers Development	A (5.2)	A (4.9)	A (5.9)	A (6.9)
2021 with Cavaliers Development <i>With I-95 Off-Ramp Project</i> ⁹	-	-	D (54.5)	B (18.3)

⁷ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁸ HCS 2010 Methodology does not support analysis of the future lane configuration and traffic signal phasing at the intersection of Churchmans Road (DE Route 58) & I-95 SB off-ramp (with DelDOT's planned I-95 Off-Ramp Widening project). Therefore, McCormick Taylor utilized Synchro results for analysis of future scenarios with the planned off-ramp modifications at that intersection.

⁹ The analysis of this scenario reflects the current preferred alternative for DelDOT's I-95 Off-Ramp Widening Project, which would provide two lanes from the I-95 southbound off-ramp to westbound Churchmans Road (DE Route 58), signalize that merge, and modify the existing off-ramp left-turn lane (signalized movement to eastbound Churchmans Road) to provide approximately 300 feet of storage. There is a large increase in overall intersection delay (and associated LOS drop) at this intersection when the I-95 Off-Ramp Project is introduced because the off-ramp movement to westbound Churchmans Road becomes signalized (this is a change from the existing free-flow condition) and the westbound Churchmans Road through movement has to stop at the signal not just for the low-volume off-ramp left-turn phase but also for the high-volume off-ramp right-turn phase. The decision to signalize the off-ramp right-turn movement was made primarily due to safety concerns regarding the potential for weaving on westbound Churchmans Road between the two-lane off-ramp merge with westbound Churchmans Road and the nearby signal at the Del Tech Access driveway.

Table 7
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ¹⁰	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
5) Churchmans Road (DE Route 58) & Cavaliers Country Club Drive				
2017 Existing	B (13.2)	A (9.7)	B (19.0)	B (17.6)
2021 without Cavaliers Development	B (14.9)	B (16.3)	B (17.9)	B (16.7)
2021 with Cavaliers Development <i>With Proposed Improvements</i> ¹¹	B (18.0)	C (21.6)	C (21.4)	C (24.9)
2021 with Cavaliers Development <i>With DeIDOT Proposed Modifications</i> ¹²	-	-	C (22.7)	C (32.0)

¹⁰ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹¹ Improvements proposed by the developer consist of widening the northbound Cavaliers Country Club Drive approach to provide a second left-turn lane, restriping westbound Churchmans Road (DE Route 58) to provide two through lanes from this intersection to the I-95 southbound off-ramp, and extending the eastbound right-turn lane.

¹² Based on correspondence with DeIDOT, proposed modifications (beyond the developer-proposed improvements) would include channelization of the eastbound and northbound right-turns and protected-prohibited phasing for the westbound left-turn. The traffic signal splits were also optimized within the existing cycle lengths. Note that the eastbound right-turn has an existing, painted channelizing island but no yield sign to control right-turns.

Table 8
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Unsignalized Intersection ¹³	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
6) Churchmans Road (DE Route 58) & Addison Drive				
2017 Existing				
Westbound Churchmans Road – Left	B (10.6)	B (12.0)	B (10.5)	B (10.0)
Northbound Addison Drive	E (36.5)	F (306.8)	C (24.7)	D (32.6)
2021 without Cavaliers Development				
Westbound Churchmans Road – Left	B (13.1)	C (24.1)	B (11.7)	B (11.4)
Northbound Addison Drive	F (303.3)	- ¹⁴	E (41.7)	F (65.5)
2021 with Cavaliers Development <i>With Proposed Improvements</i> ¹⁵				
Westbound Churchmans Road – Left	B (14.1)	D (30.2)	B (12.0)	B (11.5)
Northbound Addison Drive	C (23.4)	F (56.1)	E (44.9) ^{16, 17}	F (72.2) ¹⁶

¹³ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁴ According to the TIS, for this scenario the northbound left-turn egress is blocked by the westbound Churchmans Road (DE Route 58) platoon during the PM peak hour, and HCM 2010 is only providing delay based on the right-turns. Therefore, the actual delay in seconds for the northbound Addison Drive approach cannot be calculated.

¹⁵ Improvements proposed by the developer consist of restriping Churchmans Road (DE Route 58) to provide a center left-turn lane that extends 150 feet east of the Addison Drive intersection.

¹⁶ The 95th percentile queue length is expected to be less than one vehicle.

¹⁷ The AM peak hour approach volume is expected to be five vehicles. As per DelDOT's Development Coordination Manual, mitigation is not required for any LOS problem on a stop-controlled approach with a projected volume of ten or less vehicles per hour.

Table 9
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Unsignalized Intersection ¹⁸	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
7) Churchmans Road (DE Route 58) & Artesian Driveway/ Medical Office Driveway ¹⁹				
2017 Existing				
Eastbound Churchmans Road – Left	A (9.4)	A (9.3)	A (9.3)	A (9.3)
Westbound Churchmans Road – Left	A (9.1)	A (0.0)	A (9.1)	A (0.0)
Northbound Medical Office Driveway	A (0.0)	A (0.0)	A (0.0)	A (0.0)
Southbound Artesian Driveway	E (35.0)	D (25.7)	E (45.0)	D (31.1)
2021 without Cavaliers Development				
Eastbound Churchmans Road – Left	B (10.8)	B (10.3)	B (10.7)	B (10.4)
Westbound Churchmans Road – Left	A (9.9)	A (0.0)	A (9.9)	A (0.0)
Northbound Medical Office Driveway	A (0.0)	A (0.0)	A (0.0)	A (0.0)
Southbound Artesian Driveway	F (95.3)	F (54.8)	F (154.3)	F (80.2)
2021 with Cavaliers Development				
Eastbound Churchmans Road – Left	B (10.9)	B (10.6)	B (10.8)	B (10.6)
Westbound Churchmans Road – Left	B (10.2)	A (0.0)	B (10.2)	A (0.0)
Northbound Medical Office Driveway	A (0.0)	A (0.0)	A (0.0)	A (0.0)
Southbound Artesian Driveway	F (112.9)	F (63.6)	F (185.9) ²⁰	F (95.5) ²⁰

¹⁸ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁹ The eastbound approach has an existing left-turn bypass lane. Both the TIS and McCormick Taylor approximated this geometry by coding an exclusive eastbound left-turn lane.

²⁰ The 95th percentile queue length is expected to be less than three vehicles.

Table 10
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahan Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ²¹	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
8) Churchmans Road (DE Route 58) & Gooding Drive ²²				
2017 Existing	A (5.9)	A (4.2)	A (9.4)	A (9.0)
2021 without Cavaliers Development	A (6.9)	A (6.7)	B (12.3)	B (12.8)
2021 with Cavaliers Development	A (7.3)	A (6.9)	B (13.1)	B (13.1)

²¹ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

²² HCS 2010 Methodology does not support analysis of the existing lane configuration and traffic signal phasing at this intersection (protected/permitted left-turn phasing without a separate left-turn lane on the westbound approach). Therefore, both the TIS and McCormick Taylor utilized Synchro results for this intersection.

Table 11
PEAK HOUR LEVELS OF SERVICE (LOS)
Based on Traffic Impact Study Report for the Cavaliers Development
Prepared by McMahon Associates, Inc.
Report dated November 14, 2017

Signalized Intersection ²³	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
9) Churchmans Road (DE Route 58) & Airport Road (DE Route 37) ²⁴				
2017 Existing	D (35.8)	C (31.7)	D (45.6)	D (37.3)
2021 without Cavaliers Development	D (42.4)	D (37.4)	E (61.1)	D (42.2)
2021 with Cavaliers Development	D (42.9)	D (38.5)	E (65.0)	D (43.0)
2021 with Cavaliers Development <i>With Optimized Traffic Signal Splits</i>	-	-	D (42.6)	-

²³ For both unsignalized and signalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

²⁴ The TIS coded the eastbound channelized right-turn as signalized. Based on McCormick Taylor's field investigation, this turn is a yield condition. McCormick Taylor coded the yield condition for all cases.