

Traffic Impact Study

for

Valhalla Brandywine



Wallace Township,
Chester County,
Pennsylvania



Prepared for:
Valhalla Brandywine Partners, LP
October 14, 2008



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Executive Summary

Valhalla Brandywine Partners, LP proposes Valhalla Brandywine, a community consisting of 275 new single family homes, an 18-hole golf course, a recreation/spa/wellness center, and a country club located on the west sides of Little Conestoga Road and Chalfant Road, on both sides of Marshall Road, and on the south side of Fairview Road, in Wallace Township, Chester County, Pennsylvania. Access to the site is proposed via driveways along Marshall Road, Little Conestoga Road, and Chalfant Road.

The proposed development will largely be used by its members, residents, and guests. In addition, most of the amenities on site will require membership, and only a few uses will be open to the general public. The homes and the guest suites are primary land uses for Valhalla Brandywine. These are the land uses that attract the users to the site, and then once on-site, all of the other uses represent the amenities that the members, residents and guests can enjoy. However, since not all members may reside on-site, or since some uses are open to non-members, for the purposes of estimating the trip generation, we applied a very conservative approach, whereby we accounted for several of the amenity uses, including the golf course, the public dining, the country club banquet facilities, and the recreation/spa/wellness center, independently. As such, for the purpose of this traffic impact study, the trip generation projections are estimated conservatively high, as 490 new trips (total in both directions) during the weekday morning peak hour, and 720 new trips (total in both directions) during the weekday afternoon peak hour.

Due to the nature of the site, the site-generated traffic will occur at different times throughout the day, and therefore, the traffic will not be concentrated during the weekday commuter peak hours, when traffic is heaviest on the external road system. Also, as an overriding theme of the community, use of the personal automobile will be discouraged and even unnecessary through the design of the development. Through valet parking and golf cart travel along the trails, there will be little need to use a personal vehicle to travel within the site. Therefore, there will likely be further reduction in the trip generation of the site; however, this reduction was not applied in order to portray a conservative estimate of trip generation.

Access to the homes and the Retreat (recreation/spa/wellness center) will be provided via unsignalized accesses along Marshall Road, Little Conestoga Road, and Chalfant Road. In addition, unsignalized access to the golf clubhouse will be provided to Little Conestoga Road, Devereux Road, or both. At each of the site access locations, adequate sight distance can be provided. Also, auxiliary left-turn lanes are needed and provided at all of the Marshall Road site accesses, as well as at the golf clubhouse access along Little Conestoga Road.

All of the study area intersections were subjected to detailed capacity/level-of-service analysis. Based on the results of this analysis, all of the study area intersections currently operate at acceptable levels of service (LOS).

The estimated build-out year of the development for the purposes of this traffic impact study is 2020. Therefore, in the future year 2020 without the proposed development (i.e., without Valhalla Brandywine), but with background traffic growth, traffic conditions at the Little Conestoga Road intersections with Marshall Road/Chalfant Road and Fairview Road will worsen, and several

movements will operate with delay (LOS E and F); however, if a traffic signal is provided, as warranted based on the future without development traffic volumes, these intersections will operate acceptably (LOS D or better). At the Creek Road/Fairview Road intersection, conditions will also worsen such that several movements operate with delay (LOS E and F) during the study peak hours in 2020 without the proposed development. In order for the intersection to operate acceptably, it would be necessary to install a traffic signal; however, a traffic signal is not warranted based on the future 2020 peak hour volumes. Also, at the intersection of Creek Road and Marshall Road, all movements will operate at LOS D or better during the study peak hours; however, the future 2020 peak hour traffic volumes will warrant a traffic signal at this intersection.

In the future year 2020 with the proposed development (i.e., with Valhalla Brandywine), many of the intersections will continue to operate similarly to future without development conditions, but there will be some added delay due to the additional site-generated traffic. However, with installation of traffic signals at three of the intersections, as previously described as needed/warranted in the future without the proposed development, these three intersections will continue to operate at LOS D or better, and in fact, with installation of traffic signals, the overall levels of service at these three intersections are unchanged between future without development and future with development conditions. At the Little Conestoga Road/Marshall Road/Chalfant Road intersection, construction of a roundabout will allow the intersection to operate with much improved levels of service (LOS C or better and LOS A for most approaches) as compared to future without development conditions, and further, the intersection will operate similarly to existing conditions.

Based on the traffic analysis results, as part of the development, it is proposed to construct a roundabout at the Little Conestoga Road/Marshall Road/Chalfant Road intersection, as an alternative means for traffic control (in lieu of a traffic signal). In addition to the significant traffic operational improvements, a roundabout has the added benefits of slowing traffic through the intersection, improving safety, less pollution emissions, and greater capacity/less delays.

In addition, due to concerns about the speed of traffic along Marshall Road and Chalfant Road, in connection with the construction of the site accesses along these roads, it is proposed to construct traffic calming measures. Options to consider for traffic calming along these roads could include raised pedestrian crosswalks and/or raised access intersections. These measures are beneficial to provide enhanced facilities for pedestrian crossings, as well as to slow vehicular traffic due to the raised road surface. In addition, either in conjunction with or without raised pedestrian facilities, it is recommended to consider aesthetic features along these roads, such as textured pavement, which can be beneficial to alert motorists of the intersection, as well as possible pedestrian crossing activity.

Ordinance Compliance

This section summarizes the applicable sections of the Ordinance that relate to traffic, and which are relevant to Wallace Township's conditional use proceedings.

Conditional Use Standards - Zoning Ordinance §1702

- C. *Determine that the proposed change will serve the best interests of the Township, the convenience of the community and the public welfare.*

From a traffic perspective, all accesses serving the community will be designed and constructed in accordance with all applicable Township and PennDOT standards for safe and efficient operation. Furthermore, as part of this development, it is proposed to construct a roundabout at the intersection of Little Conestoga Road and Marshall Road/Chalfant Road. This is the most critical intersection in the study area, since it carries the heaviest traffic volumes currently, and it will carry the majority of the site-generated traffic. However, with a roundabout, traffic conditions will be greatly improved in the future with the Retreat at Valhalla Brandywine, and furthermore, the intersection will operate similarly to existing conditions. In addition, the roundabout, as well as the proposed traffic calming along Marshall Road and Chalfant Road, will reduce travel speeds in the area, and increase safety for all roadway users. As such, from a traffic perspective, the plan meets the requirements of Section 1702.C of the Township's *Zoning Ordinance*.

- F. *Make every effort to guide the development of arterial and collector road frontage as defined by the Comprehensive Plan insofar as possible so as to limit the total number of new access points to a minimum and encourage the frontage of buildings on parallel marginal roads or on roads perpendicular to the highway.*

Per the Comprehensive Plan, there is no access to any streets that are classified as arterial roads. The accesses are provided only to collector or lower order roads. The proposed development limits the number of new access points to a minimum necessary to serve the development efficiently in terms of traffic operations and with respect to emergency access. Also, the development proposes an internal road system so as to limit new intersections along existing roads, and to encourage the frontage of buildings on other roads perpendicular to the existing highways. Therefore, the proposed development's internal road system limits the number of accesses onto the external road system, which are primarily collector roads, and which is consistent with the function of a collector road to gather and direct traffic from the local road system. As such, the plan meets the requirements of Section 1702.F of the Township's *Zoning Ordinance*.

- G. *Consider the suitability of the proposed location of an industrial or commercial use with respect to probable effects upon traffic patterns, and assure adequate access arrangements will be provided in order to protect arterial and collector roads from undue congestion and hazard.*

With the proposed access improvements, adequate sight distance can be provided at each of the access locations, and the access intersections will operate at acceptable levels of service, which will protect the collector roads from undue congestion or hazard. Also, fortunately, the development is located ideally to minimize undue congestion from roads within the Township. Most of the impact will be experienced at the closest nearby intersection of Little Conestoga Road and Marshall Road/Chalfant Road, which is also the most critical intersection in the study area. However, with this development, this intersection will be greatly improved in terms of traffic operations with the proposal to install a roundabout. In addition, there are other benefits associated with a roundabout at this intersection, including improved safety, reduced emissions, traffic calming, aesthetic benefits. As such, the plan meets the requirements of Section 1702.G of the Township's *Zoning Ordinance*.

- K. *Require compliance with all applicable regulations under the controlling zoning district, Article XII – General Regulations and Article XIII Supplemental and Supporting Standards.*

See the discussion in response to Section 404.3.

PCCC Ordinance - Zoning Ordinance §1323

- E.3.f *Streets and road rights of way shall comply with the internal circulation standards set forth in Section 1323.F.*

See the discussion in response to Section 1323.F.1

E.4.h Minimum Required Parking:

- (1) *Newly constructed non-residential buildings (except as otherwise provided herein below): one parking space per 1,250 square feet of gross floor area.*
- (2) *Restaurants and banquet facilities: one parking space per three (3) seats.*
- (3) *Guests Suites: one (1) parking space per guest suite.*
- (4) *Surface parking for non-residential buildings in the FRR District shall be constructed with pervious material, subject to the internal circulation standards set forth in Section 1323.F.*

All other uses shall comply with the parking requirements set forth in this Ordinance. The Board of Supervisors may permit a reduction in the number of required parking spaces if an applicant can submit a shared parking analysis to demonstrate that the parking for all of the uses will be adequately provided.

The proposed parking for the Retreat, manor house community buildings, and the golf clubhouse is shown in **Table 1** below. The parking supply is in accordance with this section of the Township's *Zoning Ordinance*.

**Table 1
Golf Clubhouse Parking Requirements**

Use	Size	Ordinance Requirement	Number of Spaces Required/Proposed
Golf Course	18 Holes	2 spaces per hole	36
Golf Clubhouse	20,400 s.f.	1 space per 1,250 s.f.	16
Golf Clubhouse Dining	170 seats	1 space per 3 seats	57

Total = 109

Retreat Parking Requirements

Use	Size	Ordinance Requirement	Number of Spaces Required/Proposed
Spa/Country Club	148,378 s.f.	1 space per 1,250 s.f.	118
Guest Suites	180 Rooms	1 space per room	180
Dining	800 Seats	1 space per 3 seats	267

Total = 565

Manor House Community Buildings Parking Requirements

Use	Size	Ordinance Requirement	Number of Spaces Required/Proposed
Community Buildings	19,381 s.f.	1 space per 1,250 s.f.	15

Total = 15

In addition to the above parking requirements, Section 1323.E.4.h also allows for a reduction in the required parking based on a shared parking analysis. The effect of shared parking will be most prominent within the Retreat portion of the site due to the mix of restaurant, guest suites, and recreation/spa/wellness center uses in this area. Due to this mix of uses, the primary users on the site (such as for the spa or guest suites) will also visit the other amenities within the Retreat. For example, the users of the guest suites will use the other amenities within the Retreat, and therefore, it is reasonable to assume that the overall parking supply within the Retreat could be reduced by as many as 180 parking spaces, which correlates to the number of guest suites. In addition, the amenities within the Retreat will also be used by the homeowners, who may walk or use some alternate form of transportation in lieu of a passenger vehicle. For

all of these reasons, and based on the theme of this development to discourage the use of a vehicle on site, it is reasonable to reduce the overall parking supply, rather than calculate the parking based on the separate needs of each use without any accounting for interaction between the uses. As such, a shared parking analysis was completed using the methodology contained in the Urban Land Institute (ULI) publication *Shared Parking, Second Edition, 2005*. In order to complete the shared parking analysis, the time of day utilization percentages outlined in the ULI publication were applied to the parking supply requirements shown in Table 1 above, and the resultant daily parking accumulation and shared parking analysis is shown in **Appendix A** for a typical weekday and a typical Saturday. Based on the results of the shared parking analysis, at 7:00 PM on a typical weekday the Retreat parking area will have 57 unused available parking spaces, and more parking spaces will be available during every other weekday hour as well as on Saturday. As such, it is proposed to hold 10 percent of the Retreat parking in reserve, which equates to 56 spaces. These 56 parking spaces can be built if necessary in the future, but by holding them in reserve, it results in more green space on the plan, if the spaces are never determined necessary. This reduction does not account for any additional reduction that may be appropriate due to the captive users within the 180 guest suites as previously referenced. Based on the parking analysis, there is adequate parking supply to serve both the Retreat and the golf club portions of the site, and therefore the plan satisfies the requirements of Section 1323.E.4.h of the Township's *Zoning Ordinance*.

E.4.i(2) Unless the Pennsylvania Department of Transportation requires a wider entrance, vehicular entrances shall be no wider than 35 feet, measured at the point where the cartway meets the right of way line.

All of the accesses are proposed to be less than 35 feet in width, unless ultimately required to be wider by PennDOT, which we do not foresee at this time. Therefore, the plan meets the requirements of Section 1323.E.4.i.(2) of the Township's *Zoning Ordinance*.

F.1 Streets. All interior streets in the FRR Flexible Rural Residential Zoning District serving a PCCC shall comply with the standards set forth in Zoning Ordinance Section 1215 applicable for Multi-family Residential Units, and all interior streets within the I Industrial Zoning District shall comply with the Commercial/Office requirements of Section 1215.

See the discussion in response to relevant provisions of Section 1215.

Underlying Zoning Ordinance

404.3 Intersections and Access: New intersections with existing public roads shall be minimized. Although two access ways into and out of subdivisions containing more than fifteen (15) lots are generally required for safety, proposals for more than two entrances onto public roads shall be discouraged if they would disrupt traffic flow.

The proposed development limits the number of new access points to a minimum necessary to serve the development efficiently in terms of traffic operations and with respect to emergency access. Also, the development proposes an internal road system so as to limit new intersections

along existing roads. Generally, there are no more than two accesses onto any one road to serve any section (based on land use) of the development. For developments with frontage on two roads, there is additional access proposed to both roads in order to allow for the efficient management of traffic entering and exiting the development. Furthermore, to the extent possible, the development provides internal connections between contiguous sections of the development (such as between the Retreat and the homes on the south side of Marshall Road), and as such, this allows for the efficient distribution of site traffic between uses, rather than redirecting all traffic onto the external road system if traveling between uses. As such, the plan meets the requirements of Section 404.3 of the Township's *Zoning Ordinance*.

Introduction

Valhalla Brandywine Partners, LP proposes Valhalla Brandywine, a community consisting of 275 new single family homes, an 18-hole golf course, a recreation/spa/wellness center, and a country club located on the west sides of Little Conestoga Road and Chalfant Road, on both sides of Marshall Road, and on the south side of Fairview Road, in Wallace Township, Chester County, Pennsylvania (**Figure 1**). Access to the site is proposed via driveways along Marshall Road, Little Conestoga Road, and Chalfant Road. The site plan of the community is shown in **Figure 2**.

The purpose of this traffic study is to present an evaluation of the incremental traffic impacts of the proposed development within the Wallace Township study area, as well as to provide recommendations regarding the proposed site access design.

Manual turning movement traffic counts were completed at nine intersections during the weekday morning peak period (7:00 AM - 9:00 AM) and the weekday afternoon peak period (4:00 PM - 6:00 PM). In order to assess existing traffic conditions, these existing traffic volumes were subjected to detailed capacity/level-of-service analysis, in accordance with accepted methodologies, for the highest peak hour during each peak period, which serves as the basis for this evaluation.

Next, future traffic volumes without Valhalla Brandywine were projected utilizing an annual traffic growth rate to account for regional traffic growth, as well as local traffic growth associated with other known area developments. The future traffic volumes were projected to the estimated build-out year (2020) of the development at each of the study intersections. The future traffic volumes without development were then subjected to detailed capacity/level-of-service analysis.

Finally, the traffic generated by Valhalla Brandywine was established and assigned to the roadway network and site accesses. The site-generated traffic volumes were added to future without-development traffic volumes, and subjected to detailed capacity/level-of-service analysis to assess the future traffic conditions with the development.

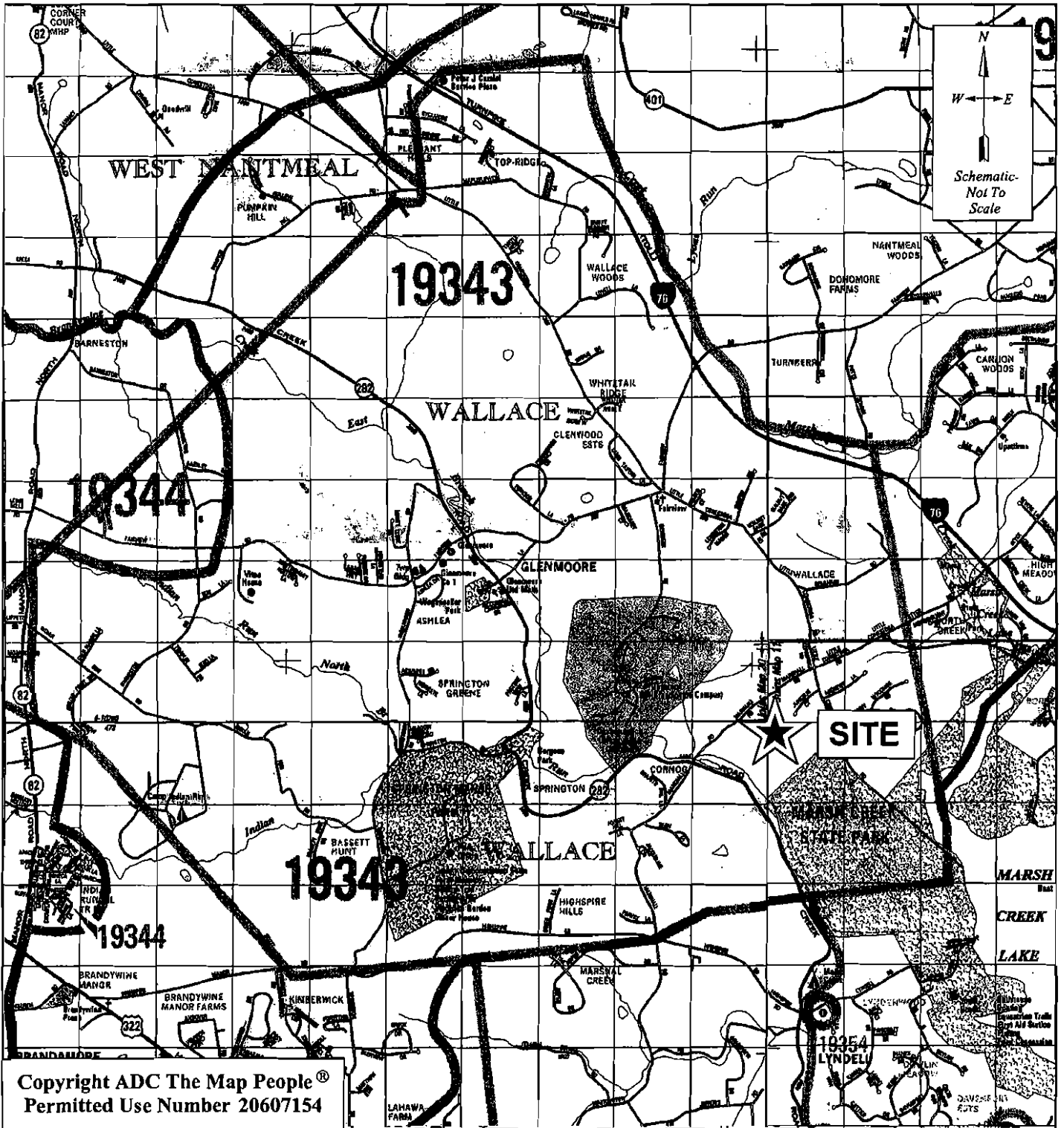


FIGURE 1
 Site Location Map
VALHALLA BRANDYWINE
WALLACE TOWNSHIP, CHESTER COUNTY, PA





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**THE RETREAT AT VALHALLA BRANDYWINE
 ILLUSTRATED CONDITIONAL USE MASTER PLAN**

Wallace Township, Pennsylvania
 September 22, 2008 • Project Number: 03.08.018.01



FIGURE 2
 Site Plan
VALHALLA BRANDYWINE
 WALLACE TOWNSHIP, CHESTER COUNTY, PA

Existing Transportation Setting

Valhalla Brandywine is located on the west side of Little Conestoga Road and Chalfant Road, on both sides of Marshall Road, and on the south side of Fairview Road, in Wallace Township, Chester County, Pennsylvania. The existing roadways and intersections in the vicinity of the site, which comprise the study area roadway network, are described in this section.

Roadway Characteristics

The study area roadway network and characteristics are summarized below in Table 2.

Table 2. Existing Roadway Characteristics

Roadway	Roadway Jurisdiction	Travel Lanes (per direction)	Shoulders	Speed Limit
Little Conestoga Road (S.R. 4016)	State	1	Varies	40 mph
Creek Road (PA Route 282)	State	1	Varies	35 mph
Fairview Road (S.R. 4031)	State	1	No	35 - 40 mph
Marshall Road (S.R. 4033)	State	1	Varies	40 mph
Devereux Road	Township	1	No	35 mph
Park Lane	Township	1	No	15 mph
Howson Lane	Township	1	No	Not Posted

The following key intersections in the vicinity of the site comprise the study area.

- Creek Road (PA Route 282) and Marshall Road
- Creek Road (PA Route 282) and Devereux Road
- Creek Road (PA Route 282) and Park Lane
- Creek Road (PA Route 282) and Fairview Road
- Little Conestoga Road and Marshall Road/Chalfant Road
- Little Conestoga Road and Fairview Road
- Fairview Road and Park Lane
- Fairview Road and Howson Lane
- Fairview Road and Devereux Road

The existing characteristics of the study intersections, including field sketches and photographs, are summarized in Appendix B.

Existing Traffic Volumes

Manual turning movement traffic counts were conducted in October 2005 and November 2007 during the weekday morning peak period (7:00 AM - 9:00 AM) and the weekday afternoon peak period (4:00 PM - 6:00 PM) for the following study intersections:

- Creek Road (PA Route 282) and Marshall Road
- Creek Road (PA Route 282) and Devereux Road
- Creek Road (PA Route 282) and Park Lane
- Creek Road (PA Route 282) and Fairview Road
- Little Conestoga Road and Marshall Road/Chalfant Road
- Little Conestoga Road and Fairview Road
- Fairview Road and Park Lane
- Fairview Road and Howson Lane
- Fairview Road and Devereux Road

The results of these traffic counts are tabulated by 15-minute intervals in **Appendix C**. The four highest consecutive 15-minute peak intervals during these traffic count periods constitute the peak hours that are the basis of this traffic analysis.

Comparison of the traffic volume data between 2005 and 2007 using Automatic Traffic Recorders at Little Conestoga Road/Marshall Road/Chalfant Road, Creek Road/Marshall Road, and Creek Road/Fairview Road reveal that the increase between 2005 and 2007 is minimal, and in some cases, the traffic volumes actually decreased from 2005 to 2007. However, the 2005 traffic counts were adjusted upward to match the 2007 traffic counts using the PennDOT growth factor for similar roadways in Chester County. In addition, PennDOT seasonal adjustment factors were reviewed to ensure that the collected traffic counts reflect typical conditions. All of the collected traffic data reflects higher than average data, and therefore, seasonal adjustment factors were not used to adjust the data. The resultant existing weekday morning and weekday afternoon peak hour traffic volumes are shown in **Figures 3 and 4**.

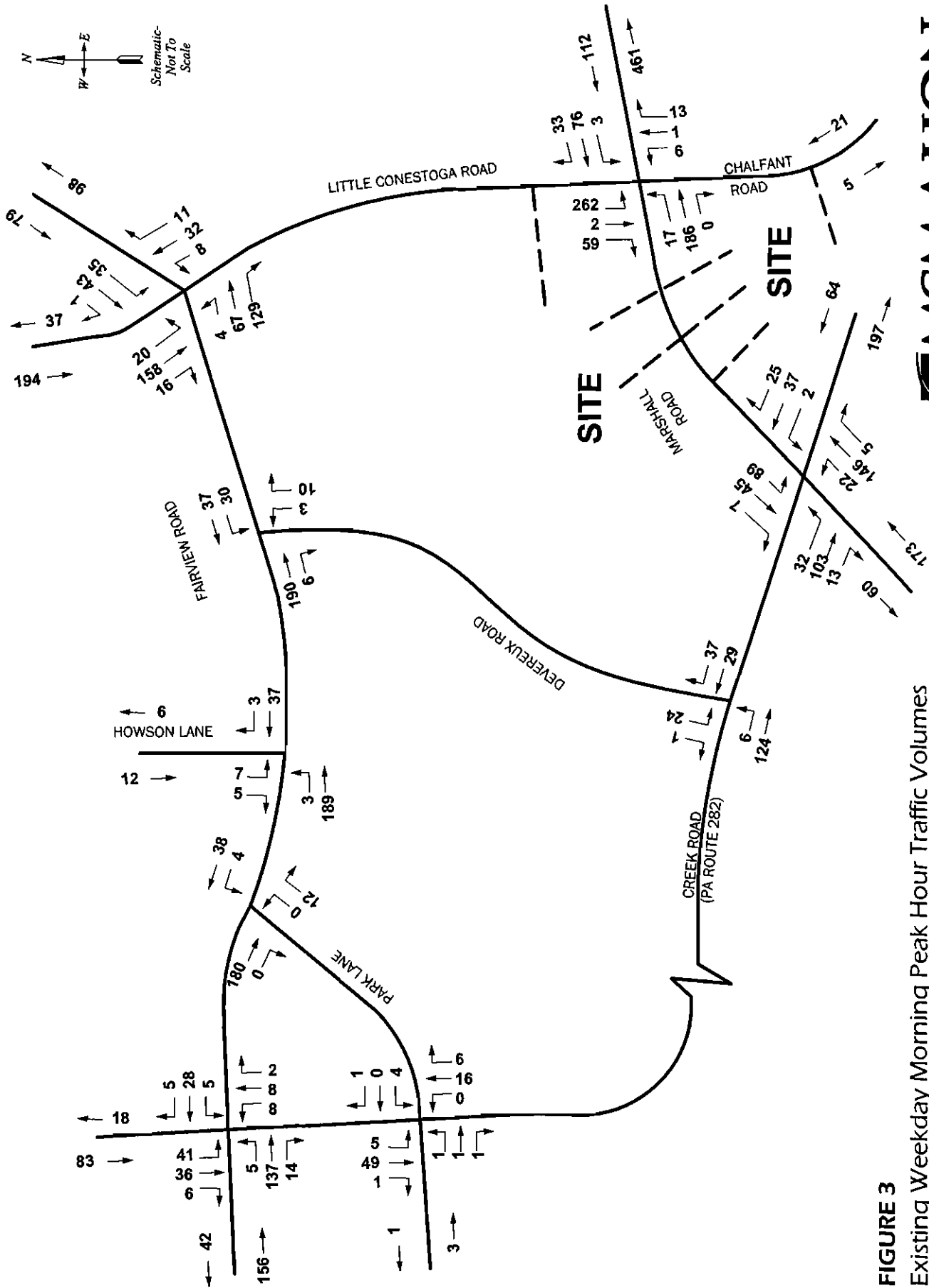


FIGURE 3

Existing Weekday Morning Peak Hour Traffic Volumes

VALHALLA BRANDYWINE

WALLACE TOWNSHIP, CHESTER COUNTY, PA



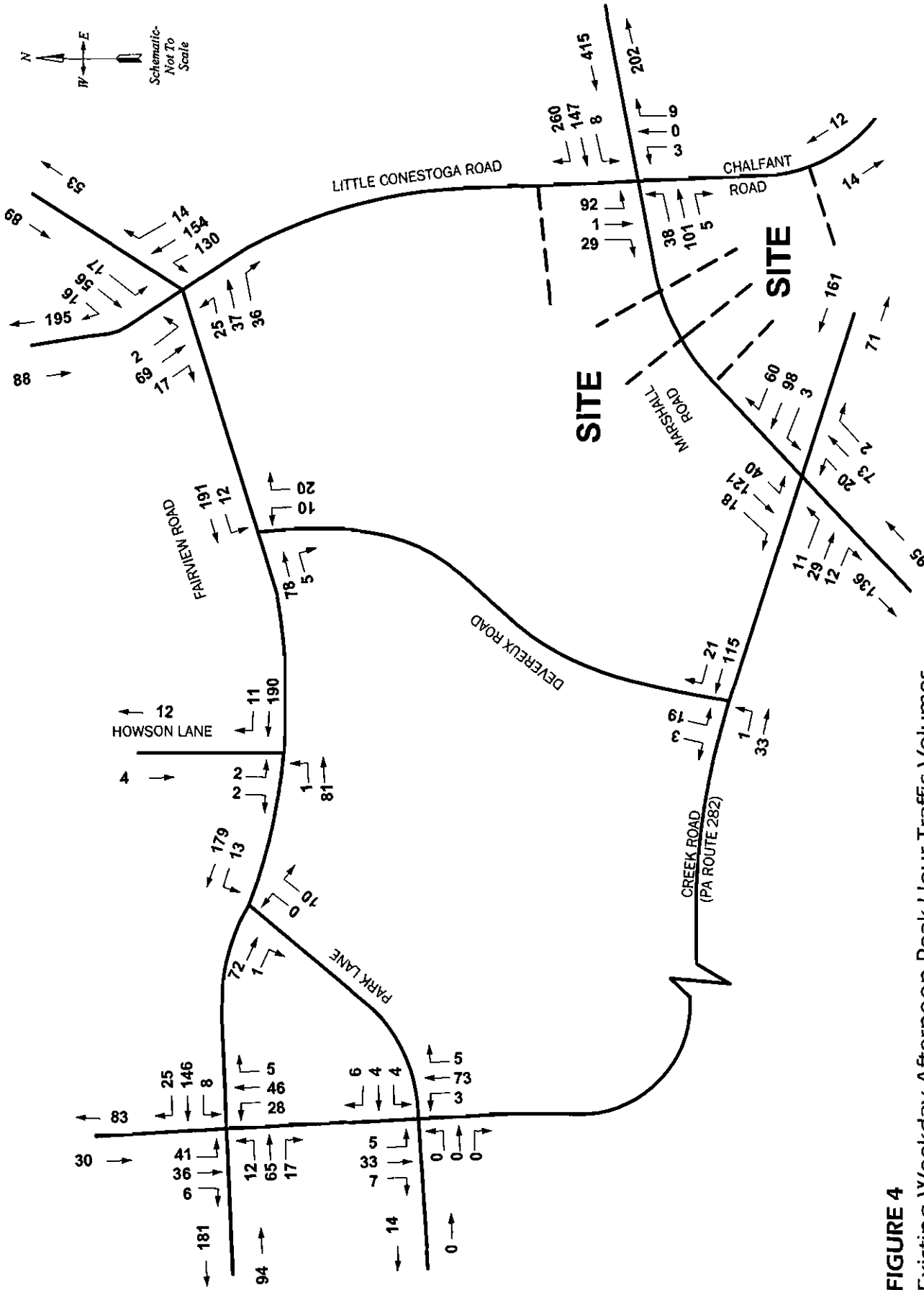


FIGURE 4
 Existing Weekday Afternoon Peak Hour Traffic Volumes
VALHALLA BRANDYWINE
WALLACE TOWNSHIP, CHESTER COUNTY, PA



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Future Traffic Volumes without Development

This section presents projected traffic volumes without the proposed development for the future year 2020, which is the estimated build-out year of the development for the purposes of this traffic study. The future year 2020 without-development traffic volumes were estimated by increasing the existing peak hour traffic volumes to account for regional and local traffic growth, as described below. The future year 2020 without-development traffic volumes are illustrated in **Figures 5 and 6** for the weekday morning and weekday afternoon peak hours, respectively.

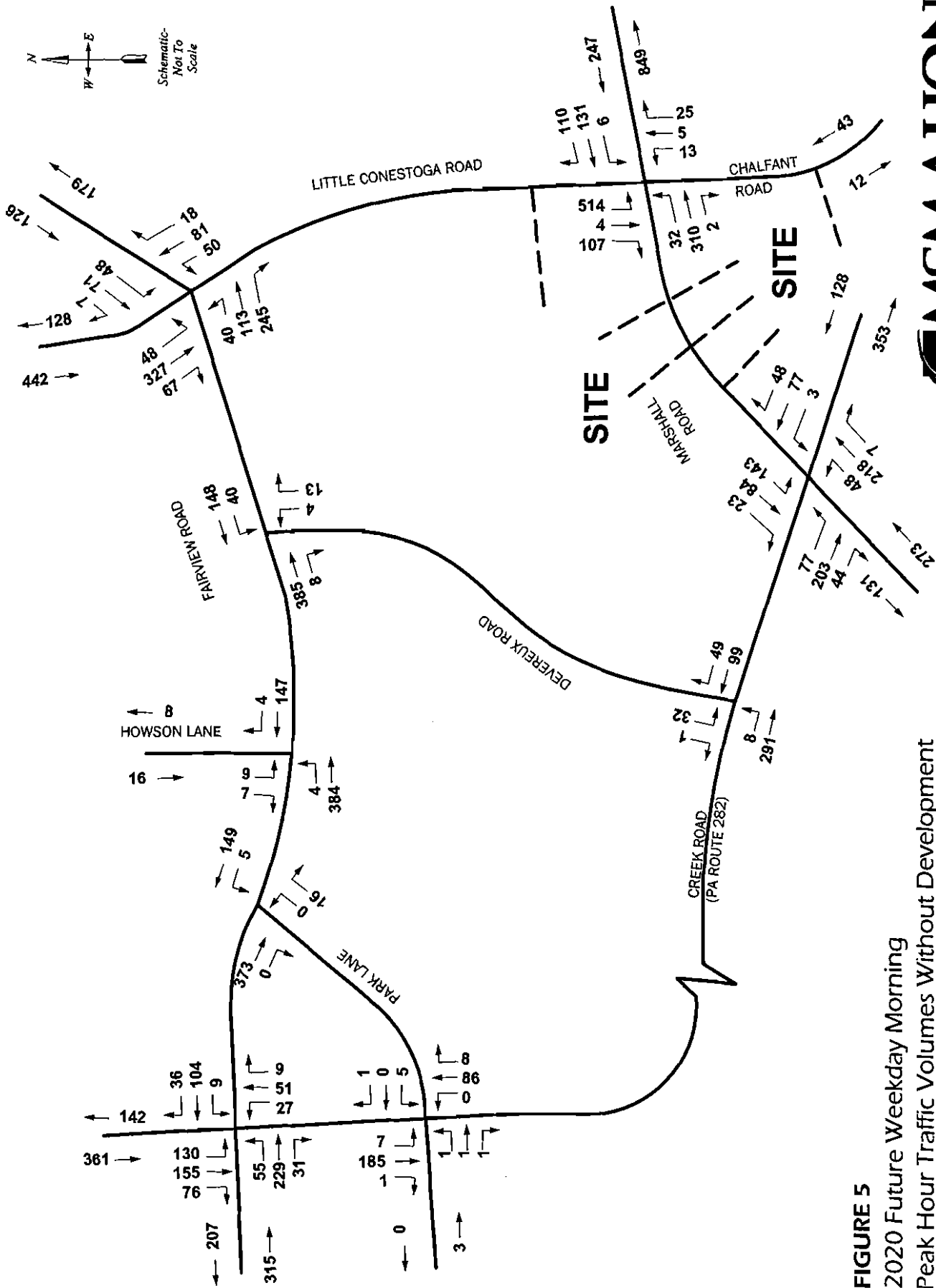
Regional Traffic Growth

To account for regional traffic growth, the existing traffic volumes were increased by an annual traffic growth rate of 2.2 percent compounded for 13 years to 2020 (33.1 percent total), which is consistent with the traffic growth rate recommended by PennDOT for similar roadways in Chester County.

Local Traffic Growth

To account for local traffic growth, Wallace Township, East Brandywine Township, West Brandywine Township, West Nantmeal Township, and Upper Uwchlan Township were contacted to identify any other future developments expected to have a significant effect on traffic conditions. Accordingly, the following 13 developments were identified and included in the future traffic volume projections:

- *Hamilton Tract Residential Development* – 492 single family homes, ten estate homes, 157 townhouses, 39 apartments, 20 apartments above the retail, a 4,800 square-foot civic use, and 20,000 square feet of retail space, located between Little Conestoga Road and Creek Road (PA Route 282), north of Fairview Road in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Wheeler Residential Development* – 21 single-family homes proposed along PA Route 282 south of Glenmoore in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Old Orchard Residential Development* – 11 single-family homes proposed along Little Conestoga Road east of Marshall Road in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Highspire Estates Residential Development* – 62 single-family homes proposed along Highspire Road west of Springton Road in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Downingtown School District Elementary School* – a 650-student elementary school proposed along Fairview Road west of Indiantown Road in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.



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FIGURE 5
 2020 Future Weekday Morning
 Peak Hour Traffic Volumes Without Development
VALHALLA BRANDYWINE
WALLACE TOWNSHIP, CHESTER COUNTY, PA

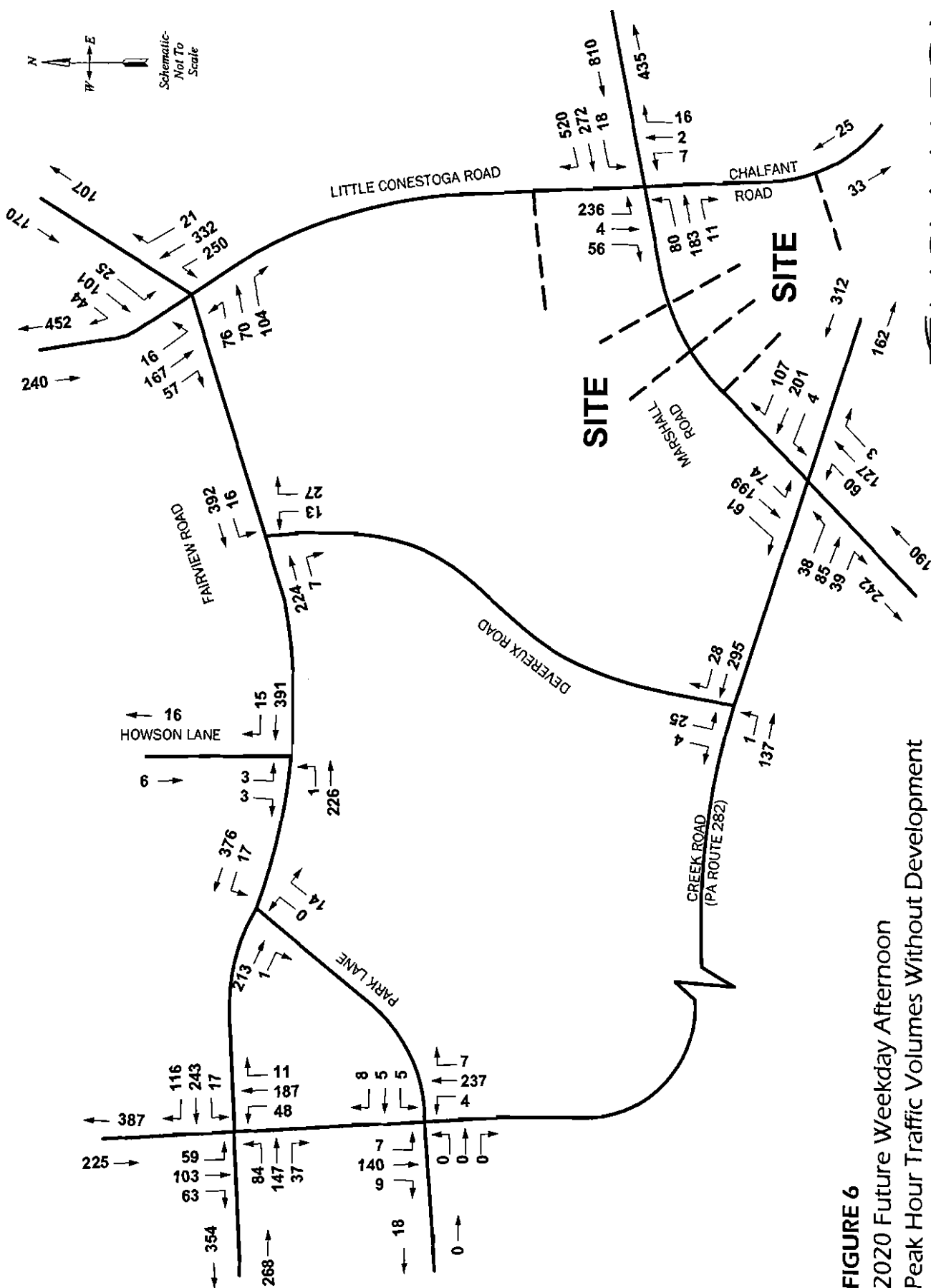


FIGURE 6
 2020 Future Weekday Afternoon
 Peak Hour Traffic Volumes Without Development
VALHALLA BRANDYWINE
WALLACE TOWNSHIP, CHESTER COUNTY, PA

- *Lakeview Subdivision* – 18 single family homes located along Chalfant Road in Wallace Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Brandywine Meadows* – 75 townhomes located along Highspire Road in West Brandywine Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Plank Property* – 34 single-family homes, 4,500 square feet of general office space, and a 3,500 square feet bank with drive through facilities located on the north side of U.S. Route 322, west of Swinehart Road in West Brandywine Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Hillendale* – 150 single-family homes and 59 townhomes located along Creek Road (PA Route 282) and Township Road in East Brandywine Township. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Hide-A-Way Farms* – 208 single-family homes located along Highspire Road between Springton Road and Marshall Road in East and West Brandywine Townships. It is noted that this development is assumed to be 100 percent built-out in 2020.
- *Frame Property Residential Development* – 70 single family homes located along Little Conestoga Road, south of Milford Road in Upper Uwchlan Township. It is noted that this development is assumed to 100 percent built-out in 2020.
- *Popjoy Property Residential Development* – 27 single family homes located along Little Conestoga Road, north of Milford Road in Upper Uwchlan Township. It is noted that this development is assumed to 100 percent built-out in 2020.
- *Wyebrooke Farms* – 123 single-family homes located along the south side of Creek Road, just west of the Creek Road/PA Route 82 intersection in West Nantmeal Township. It is noted that this development is assumed to be 100 percent built-out in 2020.

The anticipated trip generation and trip distribution/assignment for each of the other developments is provided in **Appendix D**.

Future Traffic Volumes with Development

Evaluation of Valhalla Brandywine is based upon the incremental increase in traffic volumes generated by the development during the peak hours, as described below.

Site Description

The proposed development will largely be used by its members, residents, and guests. In addition, most of the amenities on site will require membership, and only a few uses will be open to the general public. The homes and the guest suites are the primary land uses for Valhalla Brandywine. These are the land uses that attract the users to the site, and then once on-site, all of the other uses represent the amenities that the members, residents and guests can enjoy. However, as described below, since not all members may reside on-site, or since some uses are open to non-members, for the purposes of estimating the trip generation, we applied a very conservative approach, whereby we accounted for several of the amenity uses independently. A detailed description of the primary uses on the site, as well as its effect on the external trip generation is provided below:

- **Single Family Homes (275 units)** – It is envisioned that two-thirds of the homes (182 units) may be used as primary residences, and the remaining one-third of the homes (93 units) may be used as second or third homes. It is anticipated that these 93 homes will only be used part time throughout the year, or seasonally, such as in the case of an owner who spends the summer in Pennsylvania, and winter in a warmer climate. Each of the homeowners will have a membership to all Valhalla resources, including the golf course, recreation/spa/wellness center, and country club. In addition, each homeowner will be provided with a golf cart to travel within the site, which will be linked by trails, in order to minimize vehicular travel.
- **Guest Suites (180 suites)** – The guest suites will be located in the country club (100 suites) and the recreation/spa/wellness center (80 suites). The suites within the country club will be for use of members only who do not own a home on the site, and wish to stay for an extended period. In addition, the suites located in the recreation/spa/wellness center will also be available for members, but will also be open to the public (non-members).
- **Private Golf Course** – The golf course will be used exclusively by the members. The golf clubhouse will contain amenities such as a restaurant, a pro shop, and administrative offices, which are all accessory uses that are typically found at a golf course facility. The trip generation estimates for the golf course facility are treated as an independent land use, and there is no reduction taken for users of the golf course that may already be on-site at Valhalla.
- **Recreation/Spa/Wellness Center (The Retreat)** – The recreation/spa/wellness center will contain 80 guest suites, as previously described, and which is conservatively handled separately for the purpose of estimating the trip generation. Otherwise, the recreation/spa/wellness center will provide recreation activities, primarily for the guests that reside on-site (either within a guest suite or home). However, members that do not reside on-site may also take advantage of

the services and activities offered if they choose, and therefore, the trip generation estimates for the recreation/spa/wellness center are also treated as an independent land use.

- **Public Dining Options (450 seats)** – The public dining opportunities consist of a 450-seat restaurant area that will contain approximately three to five high end dining options that will be used by the members primarily; however, these restaurants will also be open to the general public. Since these restaurants will be open to the public, their trip generation estimates are handled separately. For the purposes of this analysis, it is assumed that two-thirds of the dining area (300 seats) will be occupied by “Quality Restaurant” options (Quality Restaurant is an Institute of Transportation Engineers term for a non-chain restaurant), and one-third of the dining area (150 seats) will be occupied by “High Turnover Restaurant” options (High Turnover Restaurant is an Institute of Transportation Engineers term for a chain restaurant that provides a sit down meal, but which is not fast food). Other restaurant options are provided throughout Valhalla, but they are accessory uses to the patrons of a primary use, such as the restaurant within the golf clubhouse, or within the recreation/spa/wellness center, etc.
- **Country Club** – The country club will contain a restaurant, banquet facilities, social rooms, including bowling, and 100 guest suites (as previously described). The guest suites are conservatively handled separately for the purpose of estimating the trip generation. All of the country club offerings are exclusively for the use of the members, and it is assumed that the traffic generation characteristics for the country club amenities will be the result of members that are already on the site (i.e., homeowners, guest suite residents, and other members on the site for the golf course and/or recreation/spa/wellness center, etc.). Therefore, for the most part it is not anticipated that the country club will generate new traffic destined only to the country club. However, the only other type of traffic that may be generated by the country club may be for special events (i.e., weddings, anniversary parties, etc.). These events are typically held on the weekends and in the evenings, and tend not to overlap with the typical commuter peak periods; however, in order to provide a worst-case analysis, the trip generation estimates for the banquet facilities (250 seats) was included. We assumed the trip generation for a banquet event during the highest Saturday peak period, and we assumed that all of the traffic generated for this banquet event is new external traffic, and that none of the banquet guests are already on-site. This is probably an unlikely assumption; however, these assumptions were made in order to provide a conservative estimate of the trip generation for these special events. It is also noted that when the country club is hosting a banquet event, the other uses within the country club will generally not be available to the members, and therefore, a banquet event represents the highest traffic generating use that could occur within the country club.

Membership

It is our understanding that it is planned to offer a total 2,500 family memberships, which will be available for use by every member of the family holding the membership. Of these 2,500 family memberships, 275 will be held by the owners of the homes on the site. Since most of the amenities provided on the site will be for the use of the members, the traffic operations and trip generation of this development will largely be affected by the membership.

Trip Generation

Traffic volumes generated by the proposed development were prepared based on trip generation data compiled from numerous studies contained in the Institute of Transportation Engineers (ITE) publication, *Trip Generation, 7th Edition*. As described above, the primary trip generating uses on the site will be the 275 single-family homes and the 180 guest suites. In addition, we treated the 18-hole golf course, the recreation/spa/wellness center, the public dining, and the banquet facilities within the country club separately to account for additional trip generation in order to be conservatively high in the estimates for traffic planning purposes.

In order to estimate the trip generation for the 275 homes (182 primary homes and 93 second homes) and the 180 guest suites, the trip generation rates and equations for Single Family Detached Housing (ITE Land Use Code 210), Recreational Homes (ITE Land Use Code 260), and Resort Hotel (ITE Land Use Code 330) were used. In order to estimate the trip generation for the golf course, the trip generation rates for Golf Course (ITE Land Use Code 430) were used. In order to estimate the trip generation for the public dining areas, the trip generation rates for Quality Restaurant (ITE Land Use Code 931) and High Turnover (Sit-Down) Restaurant (ITE Land Use Code 932) were used.

In order to estimate the trip generation for the country club banquet facility, trip generation rates developed by our office were used. These trip generation rates are based on traffic counts conducted by McMahan at similar facilities during the highest Saturday peak hour. Since no data is available for the weekday afternoon peak hour, the Saturday peak hour rates were used to estimate the traffic generated by the banquet facility during the weekday afternoon peak hour. In addition, it was assumed that the banquet facility would not generate traffic during the weekday morning peak hour.

A large portion of the trip generation associated with the recreation/spa/wellness center is already accounted for in the trip generation estimates for the guest suites and homes, since recreation/spa/wellness facilities are accessory uses for the on-site members. However, we have supplemented the trip generation estimates for the recreation/spa/wellness center by using Athletic Club (ITE Land Use Code 493). Again, many of the members using the recreation/spa/wellness center amenities will already be located on-site, either residing in a guest suite or within one of the homes; however, we conservatively accounted for the members that are not residing on-site, but may wish to visit the site to take advantage of these facilities. Therefore, to estimate the number of outside members that will use the recreation/spa/wellness center on a daily basis, it was assumed that of the 2,500 family memberships, 455 (275 memberships from the homes and 180 in the guest suites) are already on the site, and the remaining 2,045 memberships (or approximately 80 percent) could use the recreation/spa/wellness center on a daily basis.

In addition, since the on-site members will also be able to use all of the dining options, an internalization factor of 20 percent was applied to the public dining options only to account for the percentage of patrons that are generated from the on-site patrons (guest suites and homes). Therefore, again, the remaining customers using the public dining options (80 percent) are assumed to be generated externally, which is a very high and perhaps unlikely estimate.

Finally, because of the uniqueness of this development, and since it is not located in such a way to be visible from the surrounding road system, we did not assume any pass-by reduction to the trip generation estimates. The resultant weekday commuter peak hour trip generation estimates for the proposed site is estimated to be conservatively high for traffic planning purposes, and is shown in Table 3.

Table 3. Vehicular Trip Generation⁽¹⁾

Land Use	Size	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
		In	Out	Total	In	Out	Total
Primary Homes ⁽²⁾	182 Units	34	103	137	116	68	184
Recreational Homes ⁽³⁾	93 Units	10	5	15	10	14	24
Guest Suites ⁽⁴⁾	180 Occupied Rooms	50	20	70	33	44	77
Golf Course ⁽⁵⁾	18 Holes	32	8	40	22	27	49
Recreation/Spa/Wellness Center ⁽⁶⁾	2,045 Members	95	69	164	100	64	164
Country Club Banquet Facilities ⁽⁷⁾	250 Seats	0	0	0	70	38	108
Quality Restaurant ⁽⁸⁾ -Internal Trips ⁽⁹⁾ External Trips	300 Seats	4	5	9	52	26	78
		<u>-1</u> 3	<u>-1</u> 4	<u>-2</u> 7	<u>-10</u> 42	<u>-5</u> 21	<u>-15</u> 63
High Turnover Restaurant ⁽¹⁰⁾ -Internal Trips ⁽⁹⁾ External Trips	150 Seats	36	35	71	36	27	63
		<u>-7</u> 29	<u>-7</u> 28	<u>-14</u> 57	<u>-7</u> 29	<u>-5</u> 22	<u>-12</u> 51
Total		261	245	506	439	308	747
-Internal Trips		<u>-8</u>	<u>-8</u>	<u>-16</u>	<u>-17</u>	<u>-10</u>	<u>-27</u>
External Trips		253	237	490	422	298	720

(1) Based on the Institute of Transportation Engineers (ITE) publication, *Trip Generation, Seventh Edition*, unless otherwise noted.

(2) ITE Land Use Code 210, Single Family Detached Housing.

(3) ITE Land Use Code 260, Recreational Homes.

(4) ITE Land Use Code 330, Resort Hotel.

(5) ITE Land Use Code 430, Golf Course.

(6) ITE Land Use Code 493, Athletic Club.

(7) Based on traffic counts conducted by McMahon Associates, Inc. at similar local banquet facilities. The Saturday peak hour rates were used for the weekday afternoon peak hour. It is assumed that the banquet facilities would not generate significant traffic during the weekday morning peak hour.

(8) ITE Land Use Code 931, Quality Restaurant.

(9) An internalization rate of 20 percent was applied to the restaurant uses only.

(10) ITE Land Use Code 932, High Turnover (Sit-Down) Restaurant.

As shown in Table 3, based on the conservative trip generation assumptions previously described, the site will generate 490 new trips (total in both directions) during the weekday morning peak hour, and 720 new trips (total in both directions) during the weekday afternoon peak hour. It is noted that due to the nature of the site, the site-generated traffic will occur at different times throughout the day, and therefore, the traffic will not be concentrated during the weekday commuter peak hours, when traffic is

heaviest on the external road system. Also, as an overriding theme of the proposed community, use of the personal automobile will be discouraged and even unnecessary through the design of the facility. Valet parking will be provided on-site so that one's personal automobile is not readily available or even necessary to travel once on-site. Also, through the use of an extensive trail system, and golf cart travel along the trails, there will be little need to use a personal vehicle to travel within the site once a member arrives to the site. Therefore, there will likely be further reduction in the trip generation of the site; however, this reduction was not applied in order to portray a conservative (higher than expected) estimate of trip generation.

Trip Distribution and Assignment

Based on our understanding of the project and the anticipated market area for its members, the estimated directions of approach and departure are based on the premise that most of the membership will be drawn from outlying locations to the east, northeast and southeast of the site, and primarily from the Greater Philadelphia area. It is also envisioned that a portion of the members will reside within the Wallace Township area.

Due to the layout of the study roadway network, and the site's location relative to major highways (i.e., the Pennsylvania Turnpike, PA Route 100, U.S. Route 202, etc.), it was estimated that local members (members who live within the Wallace Township area) would arrive and depart the site differently than members who live in outlying areas. The average of these trip distributions were used to determine the overall directions of approach and departure, which are shown in **Figure 7**. Please note the following regarding the proposed directions of approach and departure:

- Within the immediate study area, the most heavily traveled intersection is Little Conestoga Road/Marshall Road/Chalfant Road, due to traffic oriented along Little Conestoga Road. This trend will carry over to the estimated trip distribution assumptions for Valhalla Brandywine. It is estimated that the majority of the site traffic (64 percent) will be destined to/from the east along Little Conestoga Road, since Little Conestoga Road links the site with PA Route 100 and the Pennsylvania Turnpike, and the majority of the members will live outside the immediate area.
- Ten percent of the traffic will be destined to/from the south along Creek Road, which connects the site to the Downingtown area as well as the U.S. Route 30 Bypass.
- Since Little Conestoga Road is a relatively heavily traveled roadway within the Township, and due to the location of the approved Hamilton Tract development, eight percent of the site traffic will be destined to/from the north of the site along Little Conestoga Road.
- Since Fairview Road to/from the east does not contain a high number of residences, and since other roadways are more convenient to access the site to/from the east (i.e., Little Conestoga Road), only two percent of the site traffic was assumed to travel to/from the east along Fairview Road.

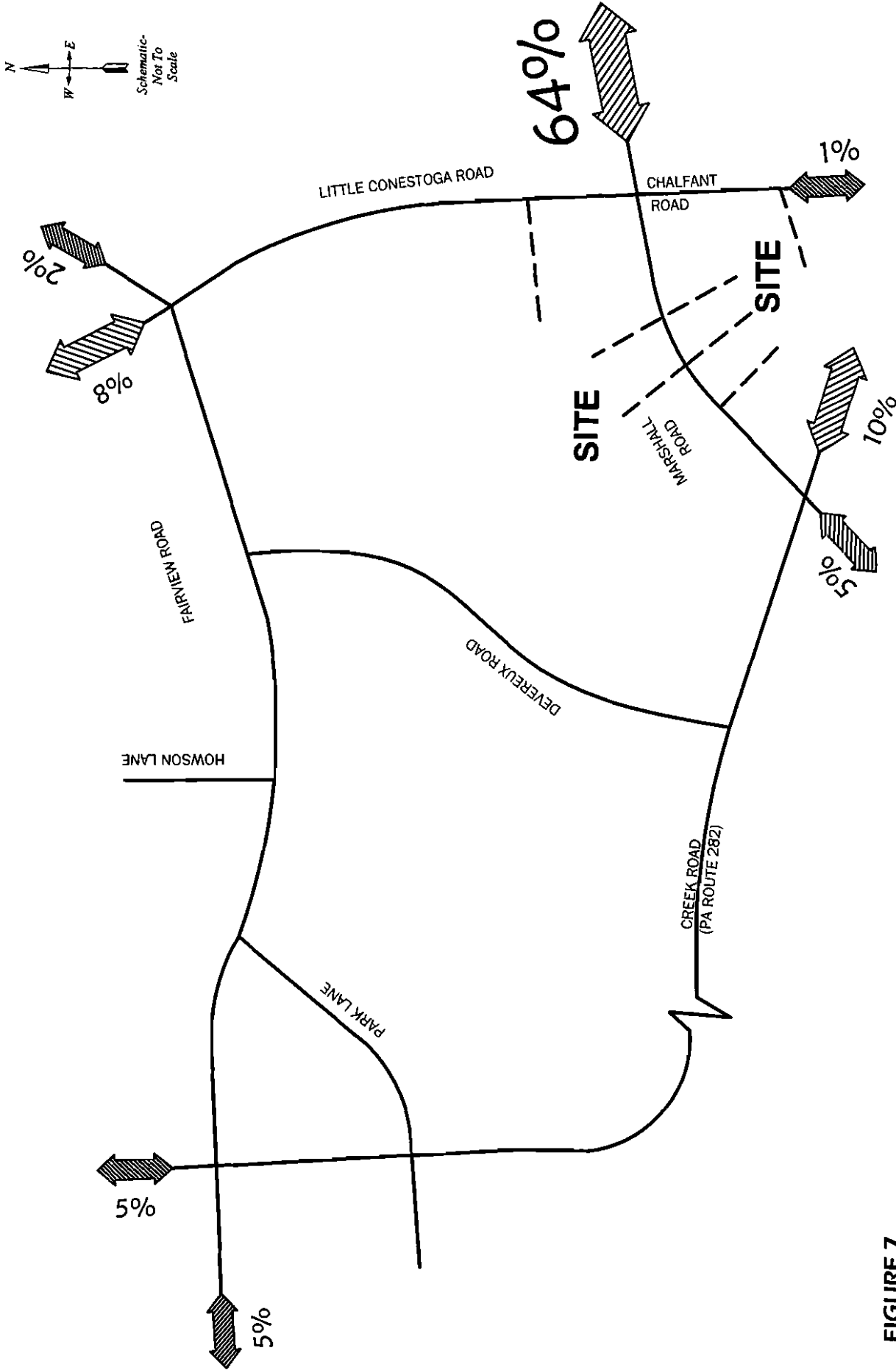


FIGURE 7
 Directions of Approach and Departure
VALHALLA BRANDYWINE
WALLACE TOWNSHIP, CHESTER COUNTY, PA

- Although not a through road, it was assumed that one percent of the site traffic will be destined to/from the south along Chalfant Road to account for local Wallace Township members.
- It was assumed that the remaining roadways (Creek Road to/from the north, Fairview Road to/from the west, and Marshall Road to/from the west) would each carry five percent of the site traffic in order to account for local members.

Application of the percentages illustrated in Figure 7 to the new peak hour trips contained in Table 3, provides an estimate of site traffic to be added to the study area. The trip distribution/assignment worksheets are contained in **Appendix E**. The site-generated traffic volumes were added to the future without-development traffic volumes to result in total future peak hour traffic volumes with development for each peak hour. The future traffic volumes with development are illustrated in **Figures 8 and 9** for the weekday morning and weekday afternoon peak hours, respectively.

Site Access/Proposed Improvements

Access to the residential portion of the development, as well as the Retreat is proposed via unsignalized driveways along Little Conestoga Road, Chalfant Road, and Marshall Road. In addition, access to the golf club portion of the development can be provided via Little Conestoga Road, Devereux Road, or both. The access alternatives for the golf club access will be discussed separately from the accesses for the rest of the development.

Access Improvements for the Homes and the Retreat

Access Configuration and Traffic Control

The proposed recommendations for the access designs, including auxiliary turn lanes, traffic control and geometric design were based on criteria and guidelines accepted by PennDOT. Specifically, the need for left-turn lanes were evaluated based on the warrants contained in the *Highway Research Record 211* and the need for right-turn deceleration lanes were based on the guidelines of the *National Cooperative Highway Research Program Report 279, Intersection Channelization Design Guide, 1985* for unsignalized intersections. Additionally, the geometric design of the proposed site accesses was preliminarily evaluated based on guidelines contained in the *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads*, PennDOT's *Publication 282 Highway Occupancy Permit Handbook*, as well as local PennDOT District policies.

Based on the results of this evaluation, all of the access intersections for the homes and the Retreat should provide one ingress lane and one egress lane. Also, each of the accesses should provide approximately 35-foot radii or as necessary based on truck turning templates. All three Marshall Road accesses warrant a separate left-turn lane along Marshall Road for access into the site. The turning lane warrant worksheets are contained in **Appendix F**.

Since Little Conestoga Road (S.R. 4016) and Marshall Road (S.R. 4033) are State Highways, the access designs will be subject to the review and approval of PennDOT for issuance of a Highway Occupancy Permit (HOP).

Sight Distance

Sight distance field measurements and evaluation were performed at each of the proposed access intersections along Marshall Road, Little Conestoga Road, and Chalfant Road. Generally, the prevailing travel speed, roadway grades and profiles, and the number of travel lanes play a role in determining if safe sight distances are available for egress and ingress at the proposed accesses. The existing sight distances at the proposed access locations were measured and compared to the Township's sight distance requirements, which refer to PennDOT's minimum sight distance requirements. These sight distance requirements are contained in *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads*.

In order to calculate the minimum sight distance requirements, speed studies were completed along Marshall Road in the vicinity of the access locations. Based on the speed studies, it was observed that the prevailing (85th percentile) speed of traffic is 41 miles per hour eastbound along Marshall Road and 42 miles per hour westbound along Marshall Road in the vicinity of the Retreat access. In addition, at the two residential accesses along Marshall Road, the 85th percentile speed of traffic is 45 miles per hour in the eastbound direction, and 43 miles per hour in the westbound direction. In addition, based on our preliminary observations only, it appears that traffic may be traveling above the posted speed limit along Little Conestoga Road in the vicinity of the site accesses closest to the Little Conestoga Road/Marshall Road/Chalfant Road intersection, and along Chalfant Road. Therefore, for calculating the required sight distance, we assumed traffic is traveling five miles per hour over the posted speed limit along these roads. It is recommended to verify the prevailing speed of traffic on these roads based on a speed study prior to final design of the accesses during the land development and PennDOT HOP process.

Table 4 summarizes the available sight distance measurements, as well as PennDOT's sight distance requirements at the proposed access locations.

Table 4. Sight Distance Evaluation

Marshall Road Recreation/Spa/Wellness Center/Country Club Access Intersection

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	+ 5.2%	40	41	309	420 ³
	Looking Right	- 8.8%	40	42	432	596
Left turn Entering	Looking Ahead	+ 5.2%	40	41	309	420
	From the Rear	- 8.8%	40	42	-	- ⁴

1 - Based on the results of the speed study, traffic is traveling 41 miles per hour in the eastbound direction and 42 miles per hour in the westbound direction along Marshall Road.

2 - Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 - Sight distance measurement assumes clearing of trees and vegetation along the site frontage.

4 - Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Western Marshall Road Residential Access Intersection (Northern Leg)

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	- 1.0%	40	43	371	600
	Looking Right	+ 1.0%	40	45	383	595
Left turn Entering	Looking Ahead	- 1.0%	40	43	371	600
	From the Rear	+ 1.0%	40	45	-	- ³

1 - Based on the results of the speed study, traffic is traveling 45 miles per hour in the eastbound direction and 43 miles per hour in the westbound direction along Marshall Road.

2 - Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 - Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Western Marshall Road Residential Access Intersection (Southern Leg)

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	+ 1.0%	40	45	383	495 ³
	Looking Right	- 1.0%	40	43	371	600
Left turn Entering	Looking Ahead	+ 1.0%	40	45	383	550
	From the Rear	- 1.0%	40	43	-	- ⁴

1 – Based on the results of the speed study, traffic is traveling 45 miles per hour in the eastbound direction and 43 miles per hour in the westbound direction along Marshall Road.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 – This measurement assumes clearing of trees and vegetation along the site frontage.

4 – Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Eastern Marshall Road Residential Access Intersection (Northern Leg)

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	- 2.9%	40	43	385	451
	Looking Right	+ 1.5%	40	45	380	760+
Left turn Entering	Looking Ahead	- 2.9%	40	43	374	377
	From the Rear	+ 1.5%	40	45	-	- ³

1 – Based on the results of the speed study, traffic is traveling 45 miles per hour in the eastbound direction and 43 miles per hour in the westbound direction along Marshall Road.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 – Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Eastern Marshall Road Residential Access Intersection (Southern Leg)

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	+ 1.5%	40	45	380	760+
	Looking Right	- 2.9%	40	43	385	441
Left turn Entering	Looking Ahead	+ 1.5%	40	45	380	700+
	From the Rear	- 2.9%	40	43	-	- ³

1 – Based on the results of the speed study, traffic is traveling 45 miles per hour in the eastbound direction and 43 miles per hour in the westbound direction along Marshall Road.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 – Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Little Conestoga Road Exit-Only Residential Access Intersection

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available ³
Exiting	Looking Left	- 1.7%	40	45	404	760+
	Looking Right	+ 4.5%	40	45	361	800+

1 – Since traffic was observed to be traveling above the posted speed limit, the prevailing travel speed along Little Conestoga Road was assumed to be 5 miles per hour over the posted speed limit.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 – Available sight distances assume clearing of trees and vegetation along the site frontage.

Chalfant Road Residential Access Intersection

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	+ 6.1%	35	40	294	700+
	Looking Right	- 5.0%	35	40	360	440
Left turn Entering	Looking Ahead	+ 6.1%	35	40	294	700+
	From the Rear	- 5.0%	35	40	360	395

1 – Since traffic was observed to be traveling above the posted speed limit, the prevailing travel speed along Chalfant Road was assumed to be 5 miles per hour over the posted speed limit.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

As shown in Table 4, all of the proposed site access locations provide adequate sight distance. At several of the accesses, as described above, it is necessary to provide vegetation clearing along the site frontage to achieve the available sight distances shown in the Table 4. At all of the site access locations, proper landscaping must be maintained and vegetation/embankment clearing must be provided along the site frontages for provision of adequate sight distance according to the above tables. Furthermore, as engineering proceeds, the available sight distances at all of the site accesses should be further verified during the detailed engineering of the site access design.

Golf Club Access Alternatives

There are several options to provide access to the golf club/residential portion of the development, as described below:

- **Scenario 1** – Access to the site will be provided via one unsignalized full-movement access along Devereux Road only.
- **Scenario 2** – Access to the site will be provided via one unsignalized full-movement access along Little Conestoga Road opposite Steepleview Drive only.
- **Scenario 3** – Access to the site will be provided via one unsignalized enter-only access along Devereux Road and one unsignalized exit-only access would be provided through Lexington Manor along Little Conestoga Road.

The operations of the site access intersections, as well as the necessary access improvements for each scenario are provided below. The results of this alternatives analysis indicate that under any access scenario, the site access will operate at acceptable LOS C or better during the peak hours, and the off-site intersections affected by the location of the golf club access will operate similarly, regardless of the golf club access scenario. The results of the analysis at the site access intersections, as well as the affected off-site intersections are shown for each access scenario. The results for scenario 1 are presented in the body of the traffic impact study, and the results for scenarios 2 and 3 are contained in Appendix G.

Scenario 1

Under this access scenario, all access to the golf club will be provided via a single full-movement access via Devereux Road. Based on the anticipated traffic volumes at the site access, auxiliary left- and right-turn lanes are not necessary. As shown in Table 5 below, adequate sight distance can be provided at this access intersection.

**Table 5
Sight Distance Evaluation
Devereux Road Golf Club Access Intersection**

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	0%	35	35	264	700+
	Looking Right	0%	35	35	264	1000+
Left turn Entering	Looking Ahead	0%	35	35	264	700+
	From the Rear	0%	35	35	264	1000+

1 – Since traffic was not observed to be traveling above the posted speed limit, the sight distance was calculated using the posted speed limit.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

Scenario 2

Under this access scenario, all access to the golf club will be provided via a single full-movement access via Little Conestoga Road opposite Steepleview Drive. Based on the anticipated traffic volumes at the site access, a northbound Little Conestoga Road left-turn lane is warranted based on PennDOT's traffic volume guidelines. Also, with regard to sight distance, our office conducted a speed study along Little Conestoga Road in the vicinity of the site access. Based on the results of the speed study, the prevailing (85th percentile) speed of traffic along Little Conestoga Road is 43 miles per hour in both directions. As shown in Table 6 below, based on the results of the sight distance evaluation adequate sight distance can be provided at this intersection.

**Table 6
Sight Distance Evaluation
Little Conestoga Road Golf Club Access Intersection**

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	+5.8%	40	43	331	830 ³
	Looking Right	-1.4%	40	43	374	406
Left turn Entering	Looking Ahead	+5.8%	40	43	331	830
	From the Rear	-1.4%	40	43	-	- ⁴

1 – Based on the results of the speed study, traffic is traveling 43 miles per hour along northbound and southbound Little Conestoga Road in the vicinity of the site access.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

3 – With tree and vegetation clearing.

4 – Since a left-turn lane is proposed, sight distance for a left-turn vehicle entering the site looking behind is not applicable.

Scenario 3

Under this access scenario, access to the golf club will be provided via one unsignalized enter-only access along Devereux Road, and one unsignalized exit-only access via Lexington Manor along Little Conestoga Road. Based on the anticipated traffic volumes at the site access, auxiliary left- and right-turn lanes are not warranted based on PennDOT’s traffic volume guidelines. Also, with regard to sight distance, our office conducted a speed study along Little Conestoga Road in the vicinity of the site access. Based on the results of the speed study, the prevailing (85th percentile) speed of traffic along Little Conestoga Road is 43 miles per hour in both directions. As shown in Table 7 below, based on the results of the sight distance evaluation adequate sight distance can be provided at both site access intersections.

Table 7
Sight Distance Evaluation
Little Conestoga Road/Lexington Manor Golf Club Access Intersection

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Exiting	Looking Left	0%	40	43	363	873
	Looking Right	0%	40	43	363	504

1 – Based on the results of the speed study, traffic is traveling 43 miles per hour along northbound and southbound Little Conestoga Road in the vicinity of the site access.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.h.2.iv.*

Devereux Road Golf Club Access Intersection

Movement	Direction	Grade	Speed (mph)		Sight Distance (feet)	
			Posted	Prevailing ¹	Required ²	Available
Left turn	Looking Ahead	0%	35	35	264	700+
Entering	From the Rear	0%	35	35	264	1000+

1 – Since traffic was not observed to be traveling above the posted speed limit, the sight distance was calculated using the posted speed limit.

2 – Based on PennDOT minimum requirements in accordance with *Pennsylvania Code, Title 67, Transportation, Chapter 441.8.*

Based on the above-described access alternatives analysis, it is evident that each of the access scenarios will accommodate the golf club and associated residential traffic volumes, such that each access will operate at acceptable levels of service (LOS C or better) during the peak hours. Furthermore, the assignment of traffic to the surrounding off-site intersections, associated with each access scenario, will not negatively change the operations at the off-site intersections. Each of the affected off-site intersections will continue to operate at similar levels of service during the peak hours, regardless of the access option. A unique benefit of Scenario 3, which provides the entering movements via Devereux Road and the exiting movements through Lexington Manor, is that the traffic volumes are more equally distributed over multiple roads, rather than directing all traffic to one road, or area of the

Township, and thereby balancing the traffic impact. In conclusion, based on the evaluation of the traffic operations, each golf club access option will adequately serve this portion of the community, and therefore, each access option can be considered for this development.

Other Proposed Improvements

In addition to the above-described site access improvements, it is proposed/recommended to construct the following additional traffic improvements in connection with this development.

Little Conestoga Road and Marshall Road/Chalfant Road Roundabout

This is a key intersection within the Township, and it is the most critical intersection surrounding the site, as it carries traffic volumes (mostly along Little Conestoga Road) to/from the east towards major highway corridors, such as PA Route 100, PA Route 401, U.S. Route 202, and the PA Turnpike. It is proposed to construct a roundabout at this intersection, as an alternative means for traffic control (in lieu of a traffic signal). Additionally, a roundabout has the added benefits of slowing traffic through the intersection, improving safety, less pollution emissions, and greater capacity/less delays. Regardless of the proposed Valhalla Brandywine development, traffic control improvements will be needed at this intersection due to anticipated increases in traffic volumes caused by growth. Also, both the Township and PennDOT have supported the installation of a roundabout in the past at this location. With construction of a roundabout, traffic conditions will be improved as compared to future traffic conditions without Valhalla, and as compared to current traffic conditions. **Appendix H** contains a concept plan and an artist rendering of a roundabout at this intersection for illustrative purposes only.

Marshall Road and Chalfant Road Traffic Calming

Due to concerns about the speed of traffic along Marshall Road and Chalfant Road, in connection with the construction of the site accesses along these roads, it is proposed to construct traffic calming measures. With regard to Marshall Road, any traffic calming measures must be approved by both the Township and PennDOT, since it is a State road. However, it is our understanding the Township is considering taking over ownership of Marshall Road from the State, which will provide the Township with more control in implementing traffic calming solutions along this road. With regard to Chalfant Road, only the Township must approve any traffic calming measures. Options to consider for traffic calming along these roads could include raised pedestrian crosswalks and/or raised access intersections. These measures are beneficial to provide enhanced facilities for pedestrian crossings, as well as to slow vehicular traffic due to the raised road surface. In addition, either in conjunction with or without raised pedestrian facilities, it is recommended to consider aesthetic features along these roads, such as textured pavement, which can be beneficial to alert motorists of the intersection, as well as possible pedestrian crossing activity. With any proposed pedestrian crossing facilities, adequate warning signing should be installed to alert motorists. These measures are offered only as suggestions, and any commitment to install traffic calming measures on these roads is subject to further review, input, and approval.

Capacity/Level-of-Service Analyses

The peak hour traffic volumes were analyzed to determine the existing operating conditions and future operating conditions, both without and with development of Valhalla Brandywine, in accordance with the standard techniques contained in the current *Highway Capacity Manual (2000)*. These standard capacity/level-of-service analysis techniques, which calculate total control delay, are more thoroughly described in **Appendix I** for both signalized and unsignalized intersections, as well the correlation between average total control delay and the respective level of service (LOS) criteria for each intersection type. In the surrounding area, PennDOT District 6-0, as well as many local municipalities, consider LOS A through D acceptable operating conditions, while LOS E represents conditions approaching capacity and LOS F indicates that traffic volumes have exceeded available capacity.

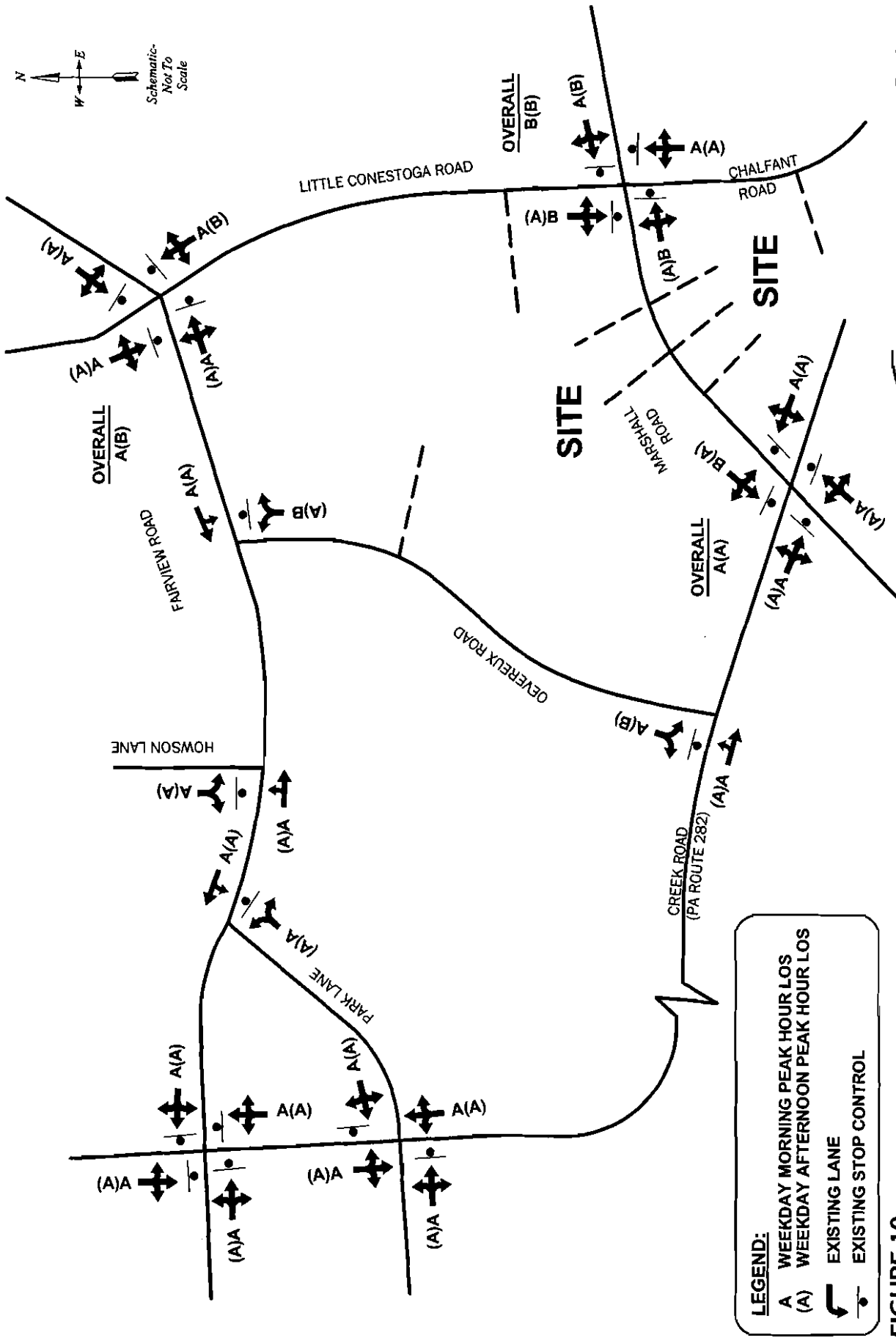
The results of the capacity/level-of-service analyses are illustrated in **Figure 10** for the existing peak hour traffic conditions, **Figure 11** for the 2020 future without-development peak hour traffic conditions, and **Figure 12** for the 2020 future with-development peak hour traffic conditions. Additionally, detailed capacity/level-of-service analysis worksheets are contained in **Appendix J, K, and L** for the existing, future-without development, and future with-development peak hour traffic conditions, respectively. The analysis results are summarized below for each study intersection.

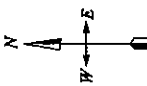
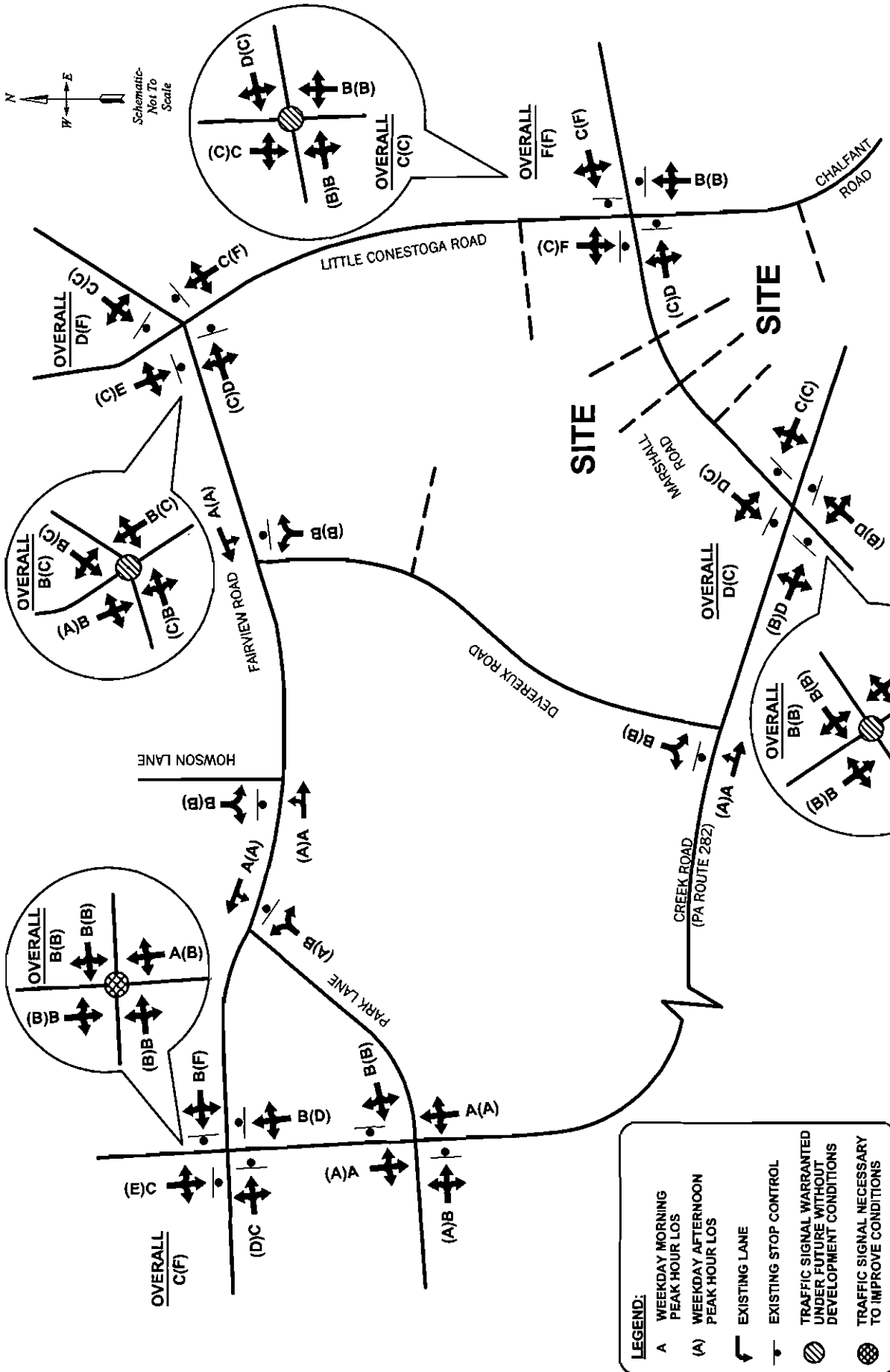
Little Conestoga Road and Marshall Road/Chalfant Road

Under existing conditions, this unsignalized all-way stop control intersection currently operates with all movements at acceptable LOS B or better during the weekday morning and weekday afternoon peak hours.

Under 2020 future without-development conditions, the southbound and westbound Little Conestoga Road approaches to the intersection will operate with delay (LOS F) due to background traffic growth. In order to improve traffic conditions at this intersection, it is necessary to install a traffic signal, which will be warranted in the future without development, or it should be considered to install other traffic control measures. It is noted that with installation of a traffic signal, the intersection will operate at acceptable LOS D or better during the study peak hours.

Under 2020 future with-development conditions with construction of a roundabout as proposed in conjunction with this development, the intersection will operate at much improved and acceptable conditions during both peak hours (LOS C for only one approach, during one peak hour, and LOS A for all other approaches). Also, with construction of a roundabout, traffic conditions at the intersection will be improved so that the intersection operates at better levels of services than in the future without Valhalla Brandywine, and at similar levels of service as experienced at the intersection today.





LEGEND:

- A WEEKDAY MORNING PEAK HOUR LOS
- (A) WEEKDAY AFTERNOON PEAK HOUR LOS
- ➔ EXISTING LANE
- ➔ EXISTING STOP CONTROL
- ⊗ TRAFFIC SIGNAL WARRANTED UNDER FUTURE WITHOUT DEVELOPMENT CONDITIONS
- ⊗ TRAFFIC SIGNAL NECESSARY TO IMPROVE CONDITIONS

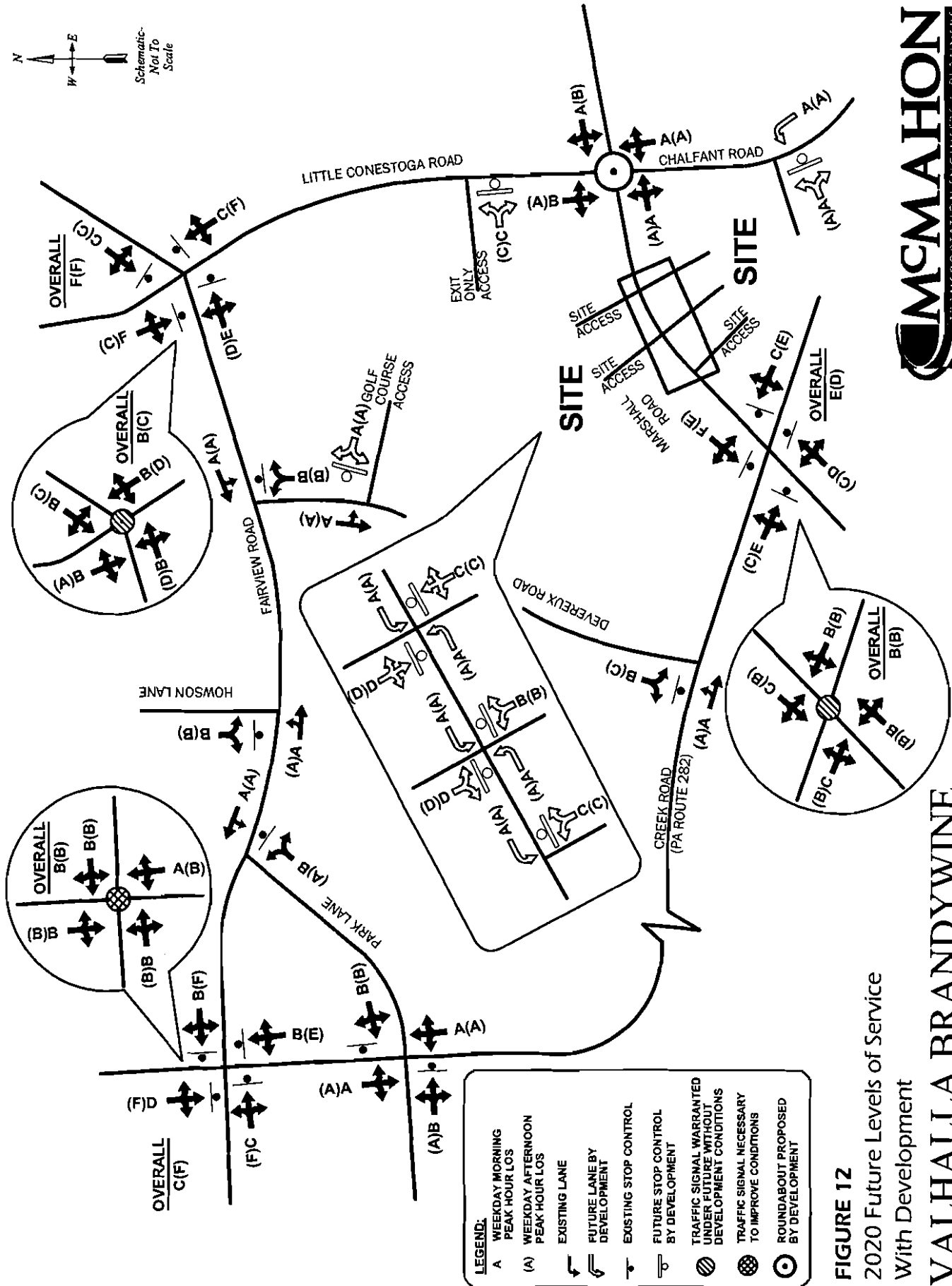
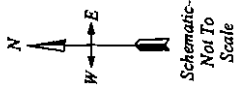
FIGURE 11

2020 Future Levels of Service Without Development
VALHALLA BRANDYWINE

WALLACE TOWNSHIP, CHESTER COUNTY, PA



(1013)08-JMP-DHW-1B) \New807140Dwg\Figures\AUG 08\Figure11.dwg



- LEGEND:**
- A WEEKDAY MORNING PEAK HOUR LOS
 - (A) WEEKDAY AFTERNOON PEAK HOUR LOS
 - EXISTING LANE
 - FUTURE LANE BY DEVELOPMENT
 - EXISTING STOP CONTROL
 - FUTURE STOP CONTROL BY DEVELOPMENT
 - TRAFFIC SIGNAL WARRANTED UNDER FUTURE WITHOUT DEVELOPMENT CONDITIONS
 - TRAFFIC SIGNAL NECESSARY TO IMPROVE CONDITIONS
 - ROUNDABOUT PROPOSED BY DEVELOPMENT

FIGURE 12

2020 Future Levels of Service
With Development

VALHALLA BRANDYWINE

WALLACE TOWNSHIP, CHESTER COUNTY, PA



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Creek Road (PA Route 282) and Marshall Road

Under existing conditions, this unsignalized all-way stop control intersection currently operates with all movements at acceptable LOS B or better during the weekday morning and weekday afternoon peak hours.

Under 2020 future without-development conditions, the intersection will operate with all movements at acceptable LOS D or better during both peak hours; however, the traffic volumes indicate that a traffic signal will be warranted in the future without development based on the Peak Hour Volume Warrant contained in PennDOT's *Publication 212, Official Traffic Control Devices*.

Under 2020 future with-development conditions, the intersection will operate with delay (LOS E or F) on the eastbound Creek Road, westbound Creek Road, and southbound Marshall Road approaches for at least one peak hour. Installation of a traffic signal, which is warranted under future without-development conditions, would improve conditions at the intersection to acceptable LOS D or better. With a traffic signal, the overall level of service at this intersection is unchanged between future without development and future with development conditions.

Creek Road (PA Route 282) and Devereux Road

Under existing conditions, this unsignalized intersection currently operates at acceptable conditions (LOS B or better) during both the weekday morning and afternoon peak hours. In addition, in the future year 2020, both without and with the proposed development, the intersection will continue to operate acceptably (LOS C or better) during both peak hours.

Creek Road (PA Route 282) and Park Lane

Under existing conditions, this unsignalized intersection currently operates at acceptable conditions (LOS A) during both the weekday morning and afternoon peak hours. In addition, in the future year 2020, both without and with the proposed development, the intersection will continue to operate acceptably (LOS B or better) during both peak hours.

Creek Road (PA Route 282) and Fairview Road

Under existing conditions, this unsignalized all-way stop control intersection currently operates with all movements at acceptable conditions (LOS A) during the weekday morning and weekday afternoon peak hours.

Under 2020 future without-development conditions, the intersection will operate with movements at acceptable LOS D or better; however, due to background traffic growth, the westbound Fairview Road approach and the southbound Creek Road approach will each operate with delay (LOS E or F) during the weekday afternoon peak hour. Traffic control improvements, such as a traffic signal, would

improve the intersection to acceptable LOS D or better during both peak hours; however, a traffic signal is not warranted according to the Peak Hour Volume Warrant criteria contained in PennDOT's *Publication 212, Official Traffic Control Devices*. This intersection should be monitored in the future to determine if a traffic signal will be warranted.

Under 2020 future with-development conditions, the intersection will continue to operate with all movements at acceptable LOS D or better during the weekday morning peak hour; however, the intersection will operate with delay (LOS E or F) on all approaches during the weekday afternoon peak hour. With traffic control improvements, such as a traffic signal, as needed in future without development conditions, the intersection will operate at acceptable LOS D or better conditions during both peak hours. With a traffic signal, the overall level of service at this intersection is unchanged between future without development and future with development conditions. Again, however, a traffic signal is not warranted in the future with development, and therefore, the intersection should be monitored in the future to determine if a traffic signal will be warranted.

Fairview Road and Park Lane

Under existing conditions, this unsignalized intersection currently operates at acceptable conditions (LOS A) during both the weekday morning and afternoon peak hours. In addition, in the future year 2020, both without and with the proposed development, the intersection will continue to operate acceptably (LOS B or better) during both peak hours.

Fairview Road and Howson Lane

Under existing conditions, this unsignalized intersection currently operates at acceptable conditions (LOS A) during both the weekday morning and afternoon peak hours. In addition, in the future year 2020, both without and with the proposed development, the intersection will continue to operate acceptably (LOS B or better) during both peak hours.

Fairview Road and Devereux Road

Under existing conditions, this unsignalized intersection currently operates at acceptable conditions (LOS B or better) during both the weekday morning and afternoon peak hours. In addition, in the future year 2020, both without and with the proposed development, the intersection will continue to operate acceptably (LOS B or better) during both peak hours.

Little Conestoga Road and Fairview Road

Under existing conditions, all movements at this unsignalized, all-way stop control intersection currently operate at acceptable conditions (LOS B or better) during both peak hours.

Under 2020 future without-development conditions, the intersection will operate with movements at LOS D or better during both peak hours; however, due to background traffic growth, the southbound and northbound Little Conestoga Road approaches will operate with delay (LOS E or F) during the weekday morning and afternoon peak hours, respectively. Traffic control improvements, such as a traffic signal, would improve the intersection to acceptable LOS D or better during both peak hours, and a traffic signal is warranted based on the future without development traffic volumes according to the Peak Hour Volume Warrant criteria contained in PennDOT's *Publication 212, Official Traffic Control Devices*.

Under 2020 future with-development conditions, most movements at the intersection will operate at LOS D or better during the peak hours; however, some movements will continue to operate with delay (LOS E or F), and again, with a traffic signal, which is warranted in the future without development condition, all movements at the intersection will operate at acceptable LOS D or better during both peak hours. Also, with a traffic signal, the overall level of service at this intersection is unchanged between future without development and future with development conditions.

Site Accesses

All of the site access intersections will operate at acceptable levels of service during both peak hours with the site access improvements previously described.