

Westtown School Conditional Use
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Registration:

Professional Engineer,
PA, DE, MD and NJ

CHARLES R. HALEY, JR., P.E.
President & Principal-in-Charge: Engineering

Responsibilities:

Mr. Haley joined ELA Group, Inc., in January 1997 as a Project Engineer, and is now serving as President of ELA Group, Inc. Mr. Haley has more than 30-years experience in project management/coordination, municipal engineering services, drainage and storm water management facility design, utility infrastructure design, roadway and transportation design, and construction drawings. His experience related to athletic field planning and design includes more than 15-years of design. His responsibilities include preparation of engineering documents for the municipal permitting and construction and/or renovation of athletic fields, athletic complexes, running tracks and athletic surfacing.

Education:

University of Texas
B.S. Civil Engineering – 1983

Key Project Experience:

Professional/Technical Affiliations:

- American Society of Civil Engineers
- National Society of Professional Engineers

Storm Water Management for School District Facilities

Experience includes preparation of construction documents for the construction and/or renovation of academic facilities including design of storm water facilities and infrastructure to support the construction of parking facilities, access roadways, academic buildings, athletic facilities and public roadway improvements. Design includes preparation of documents for approvals from governmental agencies, bidding and construction, as well as, construction observation and construction administration.

Training:

- Computational Methods in Storm Water Management, 1989

- Harrisburg Area Community College (Lancaster Campus), East Lampeter Township, Lancaster County, PA – Drainage calculations and construction drawings for a 50-acre campus.
- Lampeter-Strasburg High School, West Lampeter Township, Lancaster County, PA – Drainage design and construction drawings for various site improvements and building expansions on the 110-acre campus.
- Manheim Township High School, Manheim Township, Lancaster County, PA – Drainage calculations and constructive drawings for a 140-acre Campus.
- Mazie Gable Elementary School, Red Lion Borough, York County, PA – Drainage design and construction drawings for new elementary school on 16-acre site.
- Red Lion Area High School, Red Lion Borough, York County, PA – Drainage design and construction drawings for expansion to existing high school complex including parking areas, roadway improvements and athletic field construction.

Previous Experience:

Associate Engineer
Lockwood, Andrews and Newman, Inc.
Austin, TX
10/84 – 1/89

Project Engineer
Huth Engineers/PCS Engineers & Consultants, Inc.
Lancaster, PA
1/89 – 9/90

Project Manager
Herbert, Rowland & Grubic, Inc.
Lancaster, PA
9/90 – 1/97

Athletic Field and Facility Planning and Design

Experience includes engineering design for the construction of baseball/softball fields, multi-purpose fields, stadium fields/facilities, running tracks, and related facilities including storm water drainage systems, pedestrian facilities, parking facilities, electrical services and grandstands, construction document preparation, bid and construction phase services, and development of plans and required submittal information for local land development and state permits and approvals.

Years of Experience:

Years with this firm: 21 yrs
Years with other firms: 12 yrs

- Bayard Rustin High School Stadium, West Chester Area School District, Chester County, PA – Construction of a new stadium facility to include synthetic turf field, synthetic running track, track/field venues, home and visitor grandstands, field house/locker rooms, pedestrian facilities/walkways, ticket booth/stadium entry plaza, parking facilities, and related improvements.
- Coatesville Main Campus, Coatesville Area School District, Chester County, PA – Renovation of one (1) stadium field and from natural grass to synthetic turf and construction of new "secondary" stadium facility with synthetic turf surfacing. Improvements included bleachers, paving, fencing, storm drainage, storm water detention facilities, water services, and related improvements. Project also included "D" area improvements (high jump, long jump, and pole vault) venues. Project completed using a combination of the co-operative purchasing program and public bidding.



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EXHIBIT

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Key Project Experience:

- Downingtown East High School, Downingtown Area School District, Chester County, PA – Renovation of two (2) stadium fields from natural grass to synthetic turf, including associated improvements such as paving, fencing, storm drainage, storm water detention facilities, water services, and related improvements. Project completed using combination of co-operative purchasing program and public bidding.
- East High School/Fugett Middle School Athletic Complex, West Chester Area School District, Chester County, PA – New 43-acre athletic complex including three (3) baseball fields, softball field, and three (3) multi-purpose overlay fields, field house, dugouts, retaining walls, parking areas, pedestrian walkways, and related improvements.
- Eastern York School District Athletic Field Improvement Study, Hellum and Lower Windsor Townships, York County, PA – Prepared an athletic field improvement study to provide layout, planning and cost estimates for the campus wide athletic field improvements as desired by the School District and their Athletic Staff. The improvements included renovation to existing baseball, softball and soccer fields, as well as, repair of the existing track and replacement of the existing natural grass stadium field with a synthetic turf surface. The study also included an implementation plan for construction of the improvements in a timely fashion.
- Eastern York School District Athletic Field Renovation and New Construction, Hellum and Lower Windsor Townships, York County, PA – Preparation of construction documents and bidding of a comprehensive athletic facility improvements on the High School and Middle School Campuses. The work included athletic facility improvements to baseball, softball, soccer, and field hockey fields, fencing improvements, irrigation improvements, track repair and resurfacing, replacement of the natural grass stadium field with a synthetic turf surface, and all accessory field improvements. Township and County Conservation District permitting and bid phase services were also provided.
- Governor Mifflin High/Middle Schools, Governor Mifflin School District, Berks County, PA – Renovation of one (1) stadium field and from natural grass to synthetic turf and construction of new "secondary" stadium facility with synthetic turf surfacing. Improvements included bleachers, score boards, field lighting, public address system, paving, fencing, storm drainage, storm water detention facilities, water services, and related improvements. Project also included renovation of the existing synthetic running track and track/field venues. Project completed using co-operative purchasing program.
- Great Valley High School and Middle School Stadium and Multipurpose Construction, Great Valley School District, Chester County, PA – Replacement of the existing natural grass football field within the stadium with the installation of synthetic turf field, construction of new synthetic turf multipurpose field complex and repairs and resurfacing of the existing track within the stadium. Included construction document preparation, storm water design, permitting, and construction administration services.
- Mt. Pisgah Athletic Field Schematic Design Study (Eastern York School District), Hellum Township, York County, PA – Schematic design study to determine the feasibility and cost for the construction of a multipurpose field complex at the School District land at the intersection of Mt. Pisgah Road and Cool Creek Road. The study included the layout, planning and cost estimating for an athletic complex that included a soccer and softball field as well as access, parking, bleachers, fieldhouse, fencing and accessory items.
- Pennsylvania State University, Harrisburg Athletic Field Feasibility Study, Dauphin County, PA – Worked with staff to develop a Feasibility Study for new NCAA soccer venue and new running track.
- Saint Vincent College, West Moreland County, PA – Installation of a new synthetic turf field and renovations to an existing natural grass field used by the Pittsburgh Steelers for their Summer Camp. Included construction document preparation, retaining wall design, storm water design, permitting and construction observations.
- Shippensburg University, Seth Grove Stadium Synthetic Turf, Cumberland County, PA – Installation of a new synthetic turf field at the University's stadium. Included storm water design, approvals and construction administration services.
- Synthetic Turf Multi-Purpose Field at Ephrata Middle School, Ephrata Area School District, Lancaster County, PA – Replacement of the existing natural grass field with the installation of new synthetic turf field, construction of retaining walls surrounding the field, installation of new stadium lighting and construction of new areas for location of portable bleachers. Included construction document preparation and construction administration services.
- The Haverford School Soccer/Baseball Multi-Purpose Field, Montgomery County, PA – Removal of existing synthetic turf field and replacement with new synthetic turf field system. Improvements included construction of accessible ramps to the field, renovations to provide better subgrade drainage for the synthetic turf surface, construction of new backstop with wall/netting system and renovations to the accessory facilities located within the field complex. Included construction document preparation and construction administration services.
- West Chester Athletic Sports Association, Delaware County, PA – Replacement of the existing natural grass football and soccer fields with the installation of synthetic turf field and associated parking and seating areas. Included construction document preparation and construction administration services.
- Zimmerman Stadium, East High School/Fugett Middle School, West Chester Area School District, Chester County, PA – Renovation of existing stadium to include synthetic turf field, new synthetic running track, track/field venues, retaining wall construction, pedestrian facilities/walkways, ticket booth/stadium entry plaza, fencing, parking facilities, and related improvements.

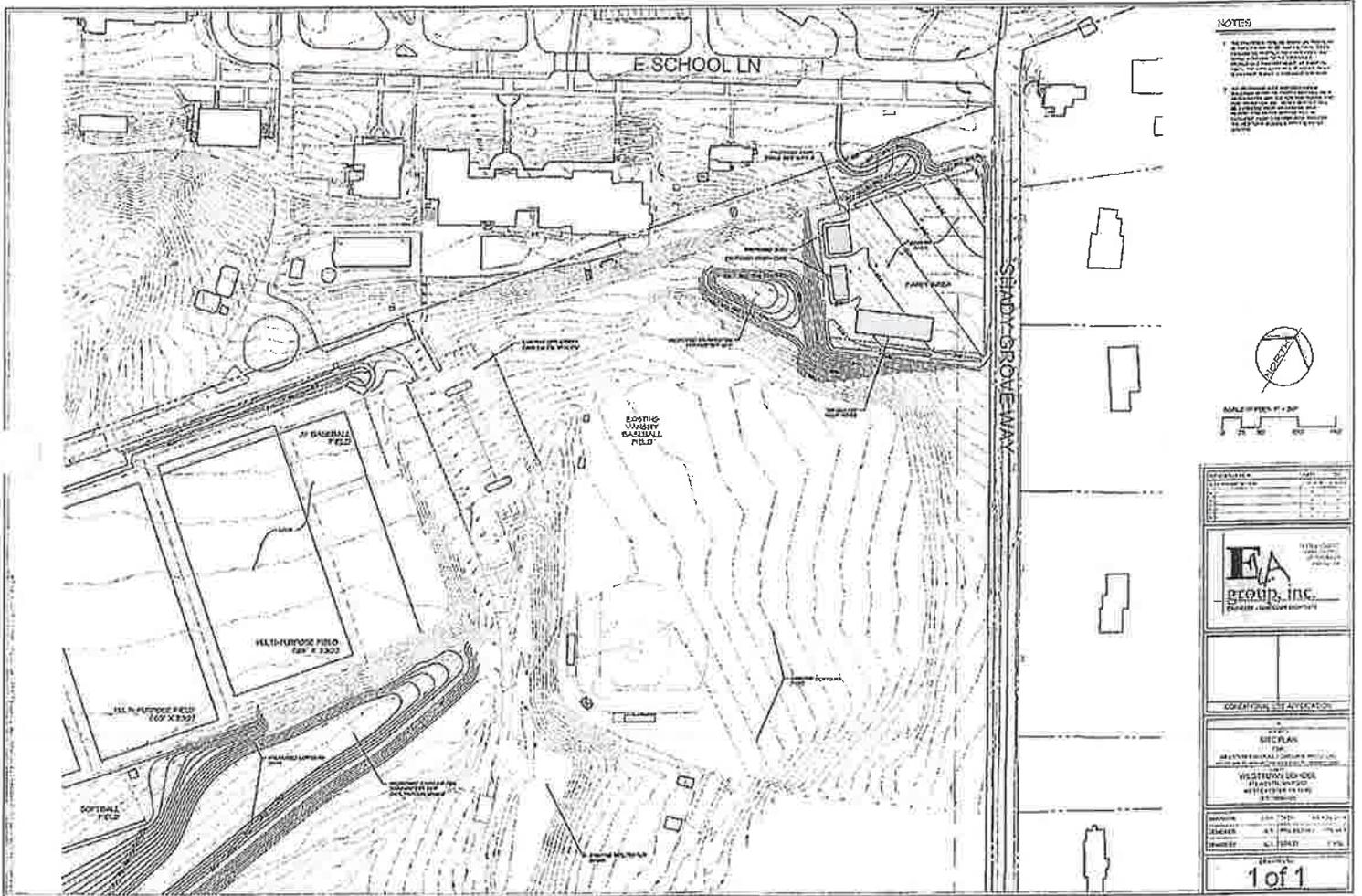
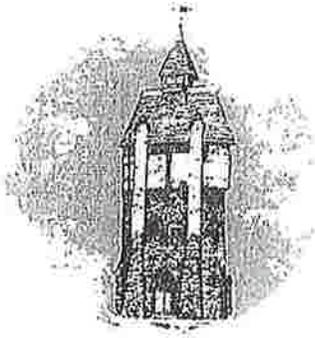


EXHIBIT
A-5



WESTTOWN TOWNSHIP

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West Chester, PA 19382
610-692-1980
email: administration@westtown.org

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FAX 610-692-0651
www.westtownpa.org

January 24, 2019

Mr. Jeffrey W. Sweater, P.E.
ELA Group, Inc.
743 South Broad Street
Lititz, PA 17543

RE: Westtown School, Lower Fields Improvements Project
Sewer Capacity Verification
ELA Project # 1091-001

Dear Mr. Sweater:

Pursuant to your November 1, 2018 letter (enclosed), please be advised that no additional sewer capacity in Westtown Township' sewage collection and treatment system is needed for the proposed fieldhouse at Westtown School's Lower Fields sports complex. This fieldhouse is part of a larger complement of proposed improvements, including artificial surface athletic fields with lights for night time use and an all-weather parking lot.

Your request for sewer capacity verification is associated with Westtown School's application to Westtown for approval of a Conditional Use to install and operate the field lights, as well as an associated application to amend Westtown Ordinance 170-1514 to permit operation of the lights for more than 20 nights annually.

Please call or email me at rpingar@westtown.org should you have any further questions or require additional information.

Sincerely,

A handwritten signature in black ink that reads "Robert R. Pingar".

Robert R. Pingar, P.E.
Township Manager

Cc: JoAnne Grube
Timothy Barnard, Esq.

Enclosure





Stormwater Management Narrative for
The Westtown School – Oak Lane Project
Condition Use Application

Existing Conditions

The existing site consists largely of grass athletic fields with lesser agricultural areas. For the purpose of analysis, the project site has been divided in to two drainage areas: A and B. Area A generally drains to the west and south to the Point of Interest which is located on the south side of Westtown Road where an existing swale and culvert intersect. Area B generally drains east and south through a riparian area to and Unnamed Tributary of East Branch Chester Creek. Stormwater management for each area/point of interest will be controlled independently.

Proposed Improvements

The proposed improvements include the construction of two synthetic turf fields, a fieldhouse/storage building, a paved parking area, reconfigured grass athletic fields and associated access improvements. A comprehensive stormwater management system will be implemented to control stormwater peak runoff rate, mitigate the 2-year volume increase, and provide pollutant removal to meet local and state water quality requirements

Stormwater BMPs

Stormwater from Area A will be controlled primarily by an above-ground bio-infiltration basin (Basin A). Area B will contain four primary BMPs including: two subsurface infiltration beds (B-2 & B-3) beneath the synthetic turf fields, a bio-infiltration basin (Basin B-1), and a rain garden (B-4) to control runoff from the relocated learning farm area. Additionally, the existing riparian area will be preserved with a conservation easement to ensure future protection of the receiving watercourse. Summary tables for peak runoff rate and volume control are attached to this narrative.



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(717) 626-7271

Central PA Office
2013 Sandy Drive, Suite 103
State College, PA 16803
(814) 861-6328

Western PA Office
408 North Main Street, Suite 200
Butler, PA 16001
(724) 256-9646

The Westtown School – Oak Lane Project

SUMMARY OF FLOWS - NRCS Rainfall-Runoff

Point of Interest A

PROJECT: The Westtown School - Oak Lane Project		JOB #: 1091-001					
LOCATION: Westtown Township		DATE: 10/26/2018					
COUNTY: Chester		REVISED:					
WATERSHEDS		2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
PRE-DEVELOPMENT		Flows (cfs)					
POI 'A'		4.22	8.09	11.72	17.45	22.68	28.59
Total Pre-Development							
POI 'A' Onsite (Reduction Factor)		2.44	4.67	6.77	10.08	13.10	16.51
50% Reduction		1.22	2.34	3.38	5.04	6.55	8.26
Allowable Post-Development Flow		3.00	5.76	8.34	12.41	16.13	20.34
POST-DEVELOPMENT							
A- Undetained		1.09	2.04	2.92	4.31	5.55	6.94
Basin A		0.16	0.60	1.41	2.78	3.89	12.41
Total Post-Development(Combined Hydrographs)		1.09	2.04	2.92	4.31	6.31	13.41

SUMMARY OF FLOWS - NRCS Rainfall-Runoff

Point of Interest B

PROJECT: The Westtown School - Oak Lane Project		JOB #: 1091-001					
LOCATION: Westtown Township		DATE: 10/26/2018					
COUNTY: Chester		REVISED:					
WATERSHEDS		2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
PRE-DEVELOPMENT		Flows (cfs)					
POI 'B'		8.22	16.77	24.95	37.90	49.60	62.88
Total Pre-Development							
POI 'B' Onsite (Reduction Factor)		5.72	12.07	18.25	28.11	37.04	47.19
50% Reduction		2.86	6.04	9.13	14.06	18.52	23.60
Allowable Post-Development Flow		5.36	10.74	15.83	23.85	31.08	39.29
POST-DEVELOPMENT							
Bed B-3		0.00	0.00	0.00	0.00	0.11	0.25
Bed B-2		0.11	0.35	0.69	0.65	0.91	0.92
Basin B-1		0.36	1.42	3.83	10.27	17.77	25.58
B- Undetained		2.88	5.32	7.58	11.12	14.29	17.91
Total Post-Development(Combined Hydrographs)		2.88	5.32	7.58	11.98	20.10	28.82

The Westtown School – Oak Lane Project

VOLUME SUMMARY - POI A

PROJECT: The Westtown School - Oak Lane Project
 LOCATION: Westtown Township
 COUNTY: Chester

JOB #: 1091-001
 DATE: 10/24/2018
 REVISED:

Req'd Infiltration Volume (from WS 4)				9,834 CF					
STRUCTURAL BMPS									
BMP ID	Infiltration Area (sf)	Impervious		Overall		2 YR Runoff Volume (cf)	Storage		Infiltration Volume *
		Area (sf)	LR	Area (sf)	LR		Vol. (cf) @	Elev.	
A	7,705	54,305	7.0:1	213,743	28:1	19,928	10,840	289.70	11,225
Total	7,705	54,305	7.0:1	213,743	28:1	19,928	10,840		11,225

*See Infiltration Volume Worksheets

VOLUME SUMMARY - POI B

PROJECT: The Westtown School - Oak Lane Project
 LOCATION: Westtown Township
 COUNTY: Chester

JOB #: 1091-001
 DATE: 10/24/2018
 REVISED:

Req'd Infiltration Volume (from WS 4)				51,815 CF					
STRUCTURAL BMPS									
BMP ID	Infiltration Area (sf)	Impervious		Overall		2 YR Runoff Volume (cf)	Storage		Infiltration Volume *
		Area (sf)	LR	Area (sf)	LR		Vol. (cf) @	Elev.	
B-1	18,641	38,542	2.1:1	448,415	24:1	30,161	31,828	312.00	30,161
B-2	69,875	84,280	1.2:1	84,280	1.2:1	21,251	16,656	316.50	21,251
B-3	24,725	84,280	3.4:1	84,280	3.4:1	21,251	40,973	321.50	21,251
Total	113,241	207,102	1.8:1	616,975	5:1	72,663	89,457		72,663

*See Infiltration Volume Worksheets

Worksheet 4. Change in Runoff Volume for 2-YR Storm Event (POI A)

POI A

PROJECT: The Westtown School - Oak Lane Project
Drainage Area _____
2-Year Rainfall: 3.26 in
Total Site Area: 3.04 acres
Protected Site Area: 0.00 acres
Managed Area: 3.04 acres

Existing Conditions:

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Paved/Impervious Areas	B	6,434	0.148	98	0.20	0.04	3.03	1,623
Meadow	B	138,851	3.188	58	7.24	1.45	0.36	4,195
20% Impervious Area as Meadow	B	1608	0.037	58	7.24	1.45	0.36	49
TOTAL:		146,893	3.372				3.75	5,867

Developed Conditions:

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Paved/Impervious Areas	B	49,360	1.133	98	0.20	0.04	3.03	12,452
Lawn (Good condition)	B	83,172	1.909	61	6.39	1.28	0.47	3,249
TOTAL:		132,532	3.043				3.50	15,701

2-Year Volume Increase (ft³): 9,834

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = $Q = (P-0.2S)^2 / (P+0.8S)$ where P = 2-Year Rainfall (in) S = (1000 / CN) - 10
 2. Runoff Volume (CF) = Q x Area x 1/12 Q = Runoff (in) Area = Land use area (sq. ft)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI. The use of a weighted CN value for volume calculations is not acceptable.

Worksheet 4. Change In Runoff Volume for 2-YR Storm Event

POI B

PROJECT: The Westtown School - Oak Lane Project
Drainage Area: _____
2-Year Rainfall: 3.26 in
Total Site Area: 15.61 acres
Protected Site Area: 0.00 acres
Managed Area: 15.61 acres

Existing Conditions:

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Paved/Impervious Areas	B	1,578	0.036	98	0.20	0.04	3.03	398
Meadow	B	529,377	12.153	58	7.24	1.45	0.36	15,994
20% Impervious Area as Meadow	B	394	0.009	58	7.24	1.45	0.36	12
Meadow	D	135,966		78	2.82	0.56	1.32	14,928
TOTAL:		667,315	12.198				3.75	31,332

Developed Conditions:

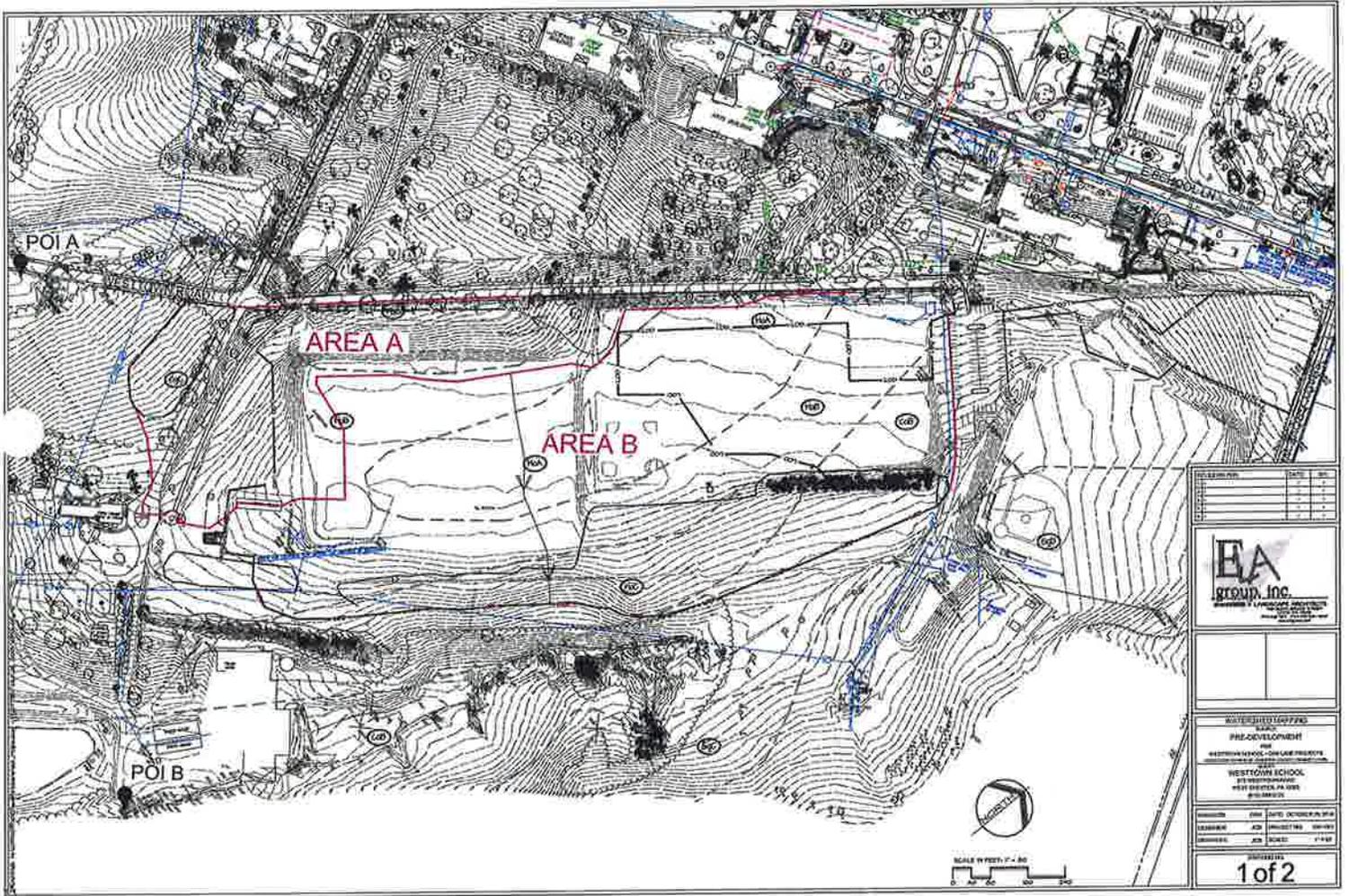
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Paved/Impervious Areas	B	213,489	4.901	98	0.20	0.04	3.03	53,857
Lawn (Good condition)	B	336,701	7.730	61	6.39	1.28	0.47	13,152
Lawn (Good condition)	D	114,897	2.638	80	2.50	0.50	1.45	13,866
Cultivated Land	D	15,069	0.346	85	1.76	0.35	1.81	2,272
TOTAL:		680,156	15.614				6.75	83,147

2-Year Volume Increase (ft³): 51,815

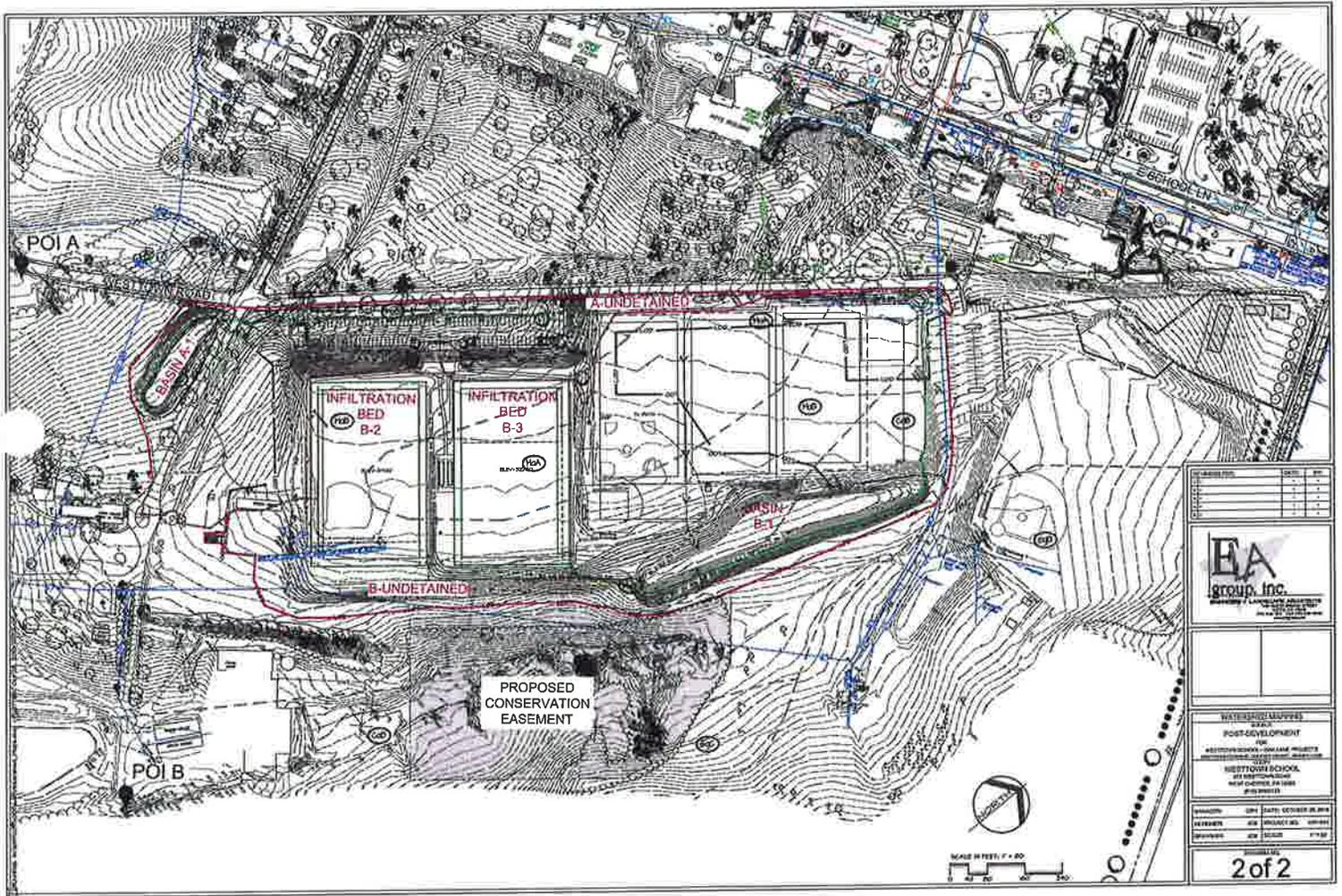
2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = $Q = (P-0.2S)^2 / (P+0.8S)$ where P = 2-Year Rainfall (in) S = (1000 / CN) - 10
 2. Runoff Volume (CF) = Q x Area x 1/12 Q = Runoff (in) Area = Land use area (sq. ft)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
 The use of a weighted CN value for volume calculations is not acceptable.**



DATE	NO.	BY
 EA group, Inc. <small>ENGINEERS ARCHITECTS</small> <small>1000 WEST 10TH AVENUE, SUITE 1000</small> <small>DENVER, CO 80202</small>		
WATER/SITE LAYOUTS PRE-DEVELOPMENT WESTVIEW MIDDLE SCHOOL WESTVIEW MIDDLE SCHOOL WESTVIEW MIDDLE SCHOOL WESTVIEW MIDDLE SCHOOL		
DESIGNED BY	DATE	PROJECT NO.
DRAWN BY	DATE	PROJECT NO.
CHECKED BY	DATE	PROJECT NO.
SHEET NO. 1 of 2		



Erich Carr Everbach

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Wallingford, PA 19086
(610) 566-5221

email: CEVERBA1@swarthmore.edu
web: <http://fubini.swarthmore.edu>

Education

Yale University, Ph.D. in Mechanical Engineering, December 1989. Dissertation title: *Tissue Composition Determination via Measurement of the Acoustic Nonlinearity Parameter*. Honors: 1989-1990 F.V. Hunt Postdoctoral Fellowship awarded by the Acoustical Society of America. Advisor: Robert E. Apfel.

Yale University, M.S. in Mechanical Engineering, May 1986.

Harvard College, B.A. in the Division of Applied Sciences, Applied Mechanics/Acoustics specialization, June 1982. Honors: Harvard Society of Engineers and Scientists Scholarship, Roger Ernst Scholarship.

Research and Teaching Experience

Professor of Engineering, Swarthmore College Engineering Dept., Swarthmore, PA, 2006 – present
Engineering Department Chair 2013 – 2018.

courses taught:

- Engineering Methodology
- Mechanics
- Electrical Circuit Analysis
- Linear Physical Systems
- Experimentation for Engineering Design
- Fluid Mechanics (senior level)
- Thermofluid Mechanics (junior level)
- Dynamics of Mechanical Systems (junior/senior level)
- Solar Energy Systems
- Exploring Acoustics
- Acoustics (senior level)
- Introduction to Environmental Protection
- Swarthmore and the Biosphere
- Capstone Seminar in Environmental Studies
- Women and Technology (see above web link)
- Human Nature, Technology, and the Environment (see above web link)

Private acoustics consultant (references upon request): Everbach Acoustics Consulting

Associate Professor with tenure, Swarthmore College, Swarthmore, PA 1996-2006.

Assistant Professor in Engineering, Swarthmore College, Swarthmore, PA, 1989 – 1996.

Visiting Professor of Mechanical Engineering, Boston University, Boston, MA, Fall 1996.

Adjunct Professor of Electrical Engineering, University of Rochester, Rochester, NY, 1990 –

Visiting Professor, Mathematics Department, Oglala Lakota College, Kyle, SD, Fall 1993.

Visiting Assistant Professor of Electrical Engineering, University of Rochester, Rochester, NY, 1989 – 1990.



Research Associate, Department of Mechanical Engineering, Yale University, 1984 – 1989.

Yale Prize Teaching Fellowship Nominee "for excellence in performance as a Teaching Fellow," Yale University, 1988.

Acoustical Engineer, Acoustic Technology Inc., Boston, MA, 9/82 to 5/84. Performed acoustical measurements, vibration analysis, environmental noise surveys, and developed a computer model for predicting sound propagation over large distances.

Professional Affiliations

Fellow of the Acoustical Society of America, elected June, 2001; chair of Biomedical Ultrasound technical committee 1999-2002, co-chair of Homepage committee 1995-2005 (<http://asa.aip.org>); member of Physical Acoustics; chair of Online Education committee 2002-2005; Education in Acoustics committee; Public Relations committee; Medals & Awards committee. Session chair at 119th (Syracuse, NY; Session EEE), 120th (San Diego, CA; Session 8PA), 124th (New Orleans; Session 5aPA), 127th (Cambridge, MA; Session 2aBA), 137th (Berlin, Germany, Session 4aBB) , and 141st (Chicago, IL), 161st (Seattle, WA) meetings of the Acoustical Society of America. Organizer and chair of special sessions at the 122nd (Houston, TX; Session 7PA), 130th (St. Louis, MO; Session 4aPA), 137th (Berlin, Germany; Session 5pBB), 140th (Newport Beach, CA; Topical Meeting on the Physics of Echo-contrast Agents), 145th (Nashville, TN; Session 1pBB), 149th (Vancouver, Canada; Session 2aBB), 151st (Providence, RI; Session 3aED), 155th (Paris, France; Sessions 4pPAc, 4pPAi), 159th (Baltimore, MD; Session 4aBB) meetings of the ASA.

American Institute of Ultrasound in Medicine

American Physical Society

American Society for Engineering Education

Elected Board Member of the Council on Undergraduate Research 1995. Chair of the Engineering Division 1999-2002.

Institute of Electrical and Electronics Engineers, Inc. Branch Counselor for the Swarthmore College Student Chapter of the IEEE.

Sigma Xi research honor society member and departmental representative

Reviewer: Journal of the Acoustical Society of America, ASME, JFM, Phys. Rev, Science.

Reviewer of grants for the National Institutes of Health, National Science Foundation, US Dept. of Agriculture.

Qualified as expert witness in acoustics, Nov. 1998, Norristown, PA county court.

Member in good standing of the National Council of Acoustical Consultants.

Advisor to Delaware County Council and Congressman Joseph Sestak on noise issues arising from a proposed FAA Airspace Redesign of the Philadelphia International Airport, 2006–2010.

Elected School Board member 2006-2009, Wallingford-Swarthmore School District, Delaware County, PA

Research Grants

Principal Investigator on grant from Lower Merion Township, PA, to research current noise ordinance applicability and to recommend improvements. Involved students in ambient noise surveys and analysis (2014).

Co-investigator with Feng Xie (PI) and Thomas R. Porter, MD (Univ. of Nebraska Cardiology Dept.) on NIH NIBIB grant 1R01EB009050-01, Sonolysis in Acute Coronary Syndromes (9/1/08-6/30/11). Provided some summer salary support and travel expenses.

Principal Investigator, NIH AREA grant, Acoustic Cavitation of Constrained Microbubbles 1 R15 EB004630-01 (3/1/05 – 12/31/06). Provided summer salary, leave support, and student research assistants to investigate the dynamics of individual microbubbles trapped in gels and blood clots subjected to ultrasound.

Co-investigator with Thomas R. Porter, MD (Univ. of Nebraska Cardiology Dept.) on American Heart Associate grant, Determining the Optimal Ultrasound Parameters for Microbubble-mediated Gene Uptake in Human Coronary Arteries, AHA reference no. 9951171Z (7/1/99-6/30/01). Provided some salary support and travel expenses.

Consultant on National Institutes of Health Lifetime Achievement Award R37CA39230-27 (Morton W. Miller, Univ. of Rochester, principal investigator) to investigate the role of acoustic cavitation in producing undesirable bioeffects when ultrasound is used with commercial echo-contrast agents 7/2/98- 7/30/02.

Co-investigator with Thomas R. Porter, MD (Univ. of Nebraska Cardiology Dept.) on American Heart Associate Grant-in-Aid, The Mechanism for Improved Ultrasound Contrast with Intermittant Imaging (7/1/97-6/30/99). Provided summer salary support and travel expenses to allow research with Dr. Porter on transient response imaging, a useful technique for imaging perfusion of blood into the heart muscle of heart attack patients that may involve microbubble destruction.

1992 Presidential Faculty Fellow of the NSF, grant number RCD 92-53777, October 1, 1992– October 1, 1997. One of only 15 fellowships each year for engineering faculty awarded nationally by the NSF, the award provided \$100,000 annually for five years to support research and teaching efforts in nonlinear dynamics at Swarthmore College.

Co-investigator with Amy Vollmer on NSF grant BES-9528168, Interaction of Intense Ultrasound with Genetically Engineered Bacteria, June 1996 - June 1997. An investigation of the effect of acoustic cavitation on *E. coli* bacteria that have been altered to produce visible light when stressed. Funds included summer salary and student research assistant support.

Co-investigator on National Institutes of Health Grant No. 2R01-DK39796-04, Role of Cavitation in Lithotripsy, June 1, 1991– June 1, 1994. The almost \$2 million grant provided \$12,000 annually to allow me and a Swarthmore student to spend summers at the University of Rochester working on lithotripsy research.

Grant-in-Aid to the American Heart Association for research into the possible undesirable side-effects of ultrasound in echocardiology, July 1992-1994. This work was a collaboration with the Department of Cardiology at the Strong Memorial Hospital, University of Rochester.

NSF Curriculum Development Grant USE-9150759, Interdisciplinary Exploration of Acoustics, July 1, 1991– Dec. 31, 1994, to develop a survey course at Swarthmore (Exploring Acoustics) primarily for non-engineering majors that teaches principles of science and engineering using analysis of sounds as a unifying theme.

NSF Instrumentation and Laboratory Improvement Grant, Graphics-based Data Acquisition and Control System, July 15, 1992 – July 14, 1994, to integrate graphics-based computers as data collection and analysis elements in existing ThermoFluids laboratories at Swarthmore.

Educational Foundation of America (EFA) grant, November 1991– May 1995, to fund development of “Swarthmore and the Biosphere,” an interdisciplinary seminar-style project-oriented course to investigate the relationship of one aspect of Swarthmore’s interaction with the environment.

Patents

Infant Health Monitoring System, Patent 5,479,932. Co-inventors are Joseph Higgins (Swarthmore '91) and Kevin J. Parker (Univ. of Rochester). The device grew out of Joe Higgins’ 1991 Senior Design Project at Swarthmore.

Swarthmore College Service

Committees: Black and Minority Affairs (SALNAAH), Women’s Studies, Public Policy, Environmental Studies (chair 1997-2000, acting chair 2001-02, member 2002-present), AAUP Executive Committee, AAUP chapter president (2005-07), Council on Educational Policy (1997-99), Linguistics, College Planning Committee 1999, Facilities Advisory Group, Land Use Planning Committee (co-chair 2002-04), Social Responsibility, Green Team (chair) of Science Project Committee, Assessment Planning Committee (2005-07), Interdisciplinary Representative to Curriculum Committee (2005-07), Sustainability Planning Committee co-chair (2007-2008), Sustainability Committee co-chair (2008-2012), Sustainability Committee member (2013- present), Inauguration Committee 2010 for Rebecca Chopp.

Student Research Assistants

Brian Acosta '17
Nii Addy '01
Yewande Adele '12
Paul Agyiri '08
Kofi Anguah '09
Joseph Armah '98
Paul Azunre '07
Fred “Nicky” Benton '02
Kara Bledsoe '16
Alyssa Bonnoit '03
Franz Chee '21
Briana Cox '17
Conor Clark '16
Evan Dorn '97
Omari Faakye '10
Alexander Flurie '05
Spencer Friske '16
James Golden '04
John “Jove” Graham '96

Engineering Senior Design Projects

Gunter Schemmann 1991
Joseph Higgins 1991
Whitney Potter 1992
Robert Boulware 1992
John Arent 1993
Olivier Colliou 1993
Joseph Jankovski 1993
Youngmoo Kim 1993
Vilma Huertas 1994
Alyssa Apsel 1995
James Hockenberry 1995
Han Park 1996
Cindy Wu 1996
Byron Holz 1998
David Bosworth 1998
Jon Makler 1998
Melissa Morrell 1999
Sarah Bergstrom 2000
Olga Rostapshova 2002

Christopher Grasberger '17
Ascanio Guarini '16
Ani Hsieh '99
Byron Holz '98
Zhazira Irgebayeva '17
Pete Jacobs '95
Suor Kim '02
Hyeongmin "Min" Kim '19
Emery Ku '05
Sylvia Kwakye '98
Frank Kyei-Manu '06
Christopher Lee '93
Christopher Lemoine '95
Carl Mas '98
Naisha Miller '98
Dianne Moise '99
Melissa Morrell '99
Laura Morrison '94
Frank Mote '00
Atousa Nourmahnad '17
Jane Ng '01
Omodayo Origunwa '18
Carol Ouellette '96
Sonal Pasarampuria '12
Daniel Pedersen '94
Sophia Peipher '20
Anjani Reddy '04
Marc Rieffel '94
Sergio Rosas '15
Jeffrey Santner '10
Tonet Santos '95
Ming Soon '93
Sierra Spencer '18
Tyler Strombom '06
Eric Studer '97
Andrew Taylor '16
Soraya Terrab BMC '14
Anteneh Tesfaye '03
Hannah Torres '20
Ali Usman '91
Cathy Vaughn '01
Roby Velez '09
Annie Willman '01
Andrea Wolfe '99
Billige "Billy" Yang '19
Chung Yuen "Brandon" Yeung '18

Johanna Yoon 2002
Katie Saltonovitz 2002
Stephen Divigneau 2003
Geoff Klein 2003
Emily Eddy 2003
Laura Zager 2003
Jesse Hartigan 2004
Milos Ilak 2004
Kristina Pao 2004
"Max" Yu Li 2005
James Golden 2005
Frank Kyei-Manu 2006
Alexey Rostapshov 2006
Aloysius Obodoako 2006
David Luong 2006
Mark Piper 2006
Tyler Strombom 2006
Paul Azunre 2007
Jesse Goodall 2007
Omer Corluhan 2008
Paul Agyiri 2008
Jonathan Shoop 2008
Paul Agyiri 2008
Anna deRegt 2009
Jonathan Shoop 2008
Anna deRegt 2009
Omari Faakye 2010
Tane Remington 2010
Anson Stewart 2010
Perry Carlson 2010
Ariel Horowitz 2010
Ryan Charmichael 2011
Janet Zarate 2011
Jonathan Martin 2012
Matthew Bowers 2012
Eric Rodrigues 2013
Katie Samuelson 2014
Remy Donahey 2014
Imoleayo Abel 2014
Cody Ruben 2014
David Lin 2015
Karl Sadueste 2015
Noah Weinthal 2015
Neal MacFarland 2015
Mercer Borris 2016
Constance Bowen 2016
Sara Brakeman 2016
Conor Clark 2016
Christine Emery 2016
Madison Heppe 2016
Jess Karol 2016
Daniel Palmer 2016
Henry Chen 2017
Michael Chen 2017

Michael "Cole" Fox 2017
Christopher Grasberger 2017
Gregory "Graham" Lesko 2017
Atousa Nourmahnad 2017
Cooper Woolston 2017
Robin Ye Linn Htun 2018
Alan Zheng Zhao 2018
Emma Giordano 2018
Omodayo-Orangunwa 2018
Isabella Branco-Lo 2018
Natasha Noguiera 2018
Ahmet Kayagil 2018
Justin Chandrasekhār 2018

Refereed Publications

Molecular mechanisms of the effect of ultrasound on the fibrinolysis of clots. I.N. Chernysh, **E. C. Everbach**, P.K. Purohit, and J.W. Weisel, Journal of Thrombosis and Haemostasis, 13:1-9, January 2015. (DOI: 10.1111/jth.12857)

Improved sonothrombolysis from a modified diagnostic transducer delivering impulses containing a longer pulse duration. J. Wu, F.Xie, T. Kumar, J. Liu, J. Lof, W.Shi, **E. Carr Everbach**, T.R. Porter, Ultrasound in Med. & Biol. Vol. 40, Issue 7, 1545–1553.

Microbubble cavitation imaging. F. Vignon, W.Shi, J. Powers, **E. Carr Everbach**, J. Liu, F. Xie, T.R. Porter, IEEE-UFFC 60(4), 661-670 (2013).

Effects of attenuation and thrombus age on the success of ultrasound and microbubble-mediated thrombus dissolution. F. Xie, **E. Carr Everbach**, S. Gao, L.K. Drvol, W.T. Shi, F. Vignon, J.E. Powers, J. Lof, T.R. Porter, Ultrasound in Med. & Biol. 37(2), 280-288 (2011).

In-Vivo Microbubble Cavitation Imaging. Vignon, F., Shi, W., Liu, J., Xie, F., Gao, S., Drvol, L., Lof, J., **Everbach, C.**, Porter, T. and Powers, J. Proceedings of the Twelfth International Symposium on Therapeutic Ultrasound, 2011, pp. 134-38.

Investigation of Image-guided Sonothrombolysis in a Porcine Acute Ischemic Stroke Model. William T. Shi, Thomas R. Porter, Vignon, Francois, Jeffrey E. Powers, Shunji Gao, Jinjin Liu, Feng Xie, Lucas Drvol, John Lof, and **E. Carr Everbach**. IEEE Ultrasonics 2011, pp 332-337.

Real-Time Two-Dimensional Imaging of Microbubble Cavitation. Thomas R. Porter, Vignon, Francois, Jeffrey E. Powers, William T. Shi, Shunji Gao, Jinjin Liu, Feng Xie, Lucas Drvol, John Lof, **E. Carr Everbach**. Proceedings of the Eleventh International Symposium on Therapeutic Ultrasound, 2011, pp. 2032-2036.

Threshold of Inertial Cavitation Induced by Diagnostic Ultrasound and Microbubbles. Vignon, Francois, Thomas R. Porter, Jeffrey E. Powers, William T. Shi, Shunji Gao, Jinjin Liu, Feng Xie, Lucas Drvol, John Lof, **E. Carr Everbach**. Proceedings of the Eleventh International Symposium on Therapeutic Ultrasound, 2011, pp. 2078-2083.

Transcranial Threshold of Inertial Cavitation Induced by Diagnostic Ultrasound and Microbubbles. Liu, J., Gao, S., Porter, T., **Everbach, C.**, Shi, W., Vignon, F., Powers, J., Lof, J., Turner, J., Xie, F. IEEE Ultrasonics Letters, Vol. 2, 2010, pp. 434-439.

Utilization of Diagnostic Transtemporal Guided High Mechanical Index Ultrasound and a Systemic Microbubble Infusion to Treat Ischemic Stroke without Fibrinolytic Agents. Porter, T., Vignon, F., Powers, J. Gao, S., Liu, J. Xie, F., and **Everbach EC**. American College of Cardiology, Letters Vol 19(3), 2010, pp. 2534-2539.

Investigation of effectiveness of microbubble stable cavitation in thrombolysis. William T. Shi, Shunji Gao, Vignon, Francois, Jeff E. Powers, Lucas Drvol, Ki Won Jung, Feng Xie, John Lof, **E. Carr Everbach**, Thomas R. Porter. IEEE 2010 Ultrasound Symposium, pp. 1743-1749.

Treatment of Acute Intravascular Thrombi with Diagnostic Ultrasound and Intravenous Microbubbles. F. Xie, J. Lof, **Carr Everbach**, A. He, R.M. Bennett, T. Matsunaga, J. Johannig, T.R. Porter. J. Am. Coll. Cardiol. Img 2, 511-518 (2009).

Bioeffects considerations for diagnostic ultrasound contrast agents. D.L. Miller, M.A. Averkiou, A.A. Brayman, **E.C. Everbach**, C.K.Holland, J.H. Wible Jr., J. Wu. *Journal of Ultrasound in Medicine* 27(4), 611-623 (2008).

American Institute of Ultrasound in Medicine consensus report on potential bioeffects of diagnostic ultrasound: Executive summary. J.B. Fowlkes, J.S. Abramowicz, C.C. Church, ... **E.C. Everbach**, ... D.G. Simpson, *Journal of Ultrasound in Medicine* 27(4), 503-515 (2008).

Diagnostic Ultrasound. **E. Carr Everbach**, invited tutorial paper, *Physics Today*, March 2007.

Characterization of individual submicron perfluorocarbon gas bubbles by ultrasonic backscatter. **E. Carr Everbach**, D.B. Khismatullin, J.T. Flaherty and R.A. Roy, *Acoustics Research Letters Online*, ARLO 6(3), 175-181(July, 2005). DOI: <http://dx.doi.org/10.1121/1.1901743>

Biological and environmental factors affecting ultrasound-induced hemolysis in vitro 2. Medium dissolved gas (pO₂) content. M.W. Miller, **E.C. Everbach**, L.F. Battaglia, *Ultrasound Med. Biol.* 29, 93-102 (2003).

Biological and environmental factors affecting ultrasound-induced hemolysis in vitro 1. HIV macrocytosis (cell size). M.W. Miller, **E.C. Everbach**, L.F. Battaglia, *Ultrasound Med. Biol.* 29, 77-91 (2003).

Enhanced Retention in the Passive-Avoidance Task by 5-HT_{1A} Receptor Blockade is not associated with increased activity of the Central Nucleus of the Amygdala. A.M. Schneider, E. Wilkins, A. Firestone, **E. Carr Everbach**, J.C. Naylor, and P. Simson, *Learning & Memory* 10:394-400 (2003).

Differences in Definity and Optison microbubble destruction rates at a similar mechanical index with different real-time perfusion systems. C. Sonne, F. Xie, J. Lof, J. Oberdorfer, P. Phillips, **E. Carr Everbach**, and T.R. Porter, *J. Am. Soc. Echocardiology* 16, 1178-1185 (2003).

Effectiveness of transcranial and thoracic ultrasound and microbubbles in dissolving intravascular thrombi. T.R. Porter, D. Kricsfeld, J. Lof, **E. Carr Everbach**, F. Xie, *J. Ultrasound Med.* 2001, 20:1313-1325.

A comparison of the hemolytic potential of Optison™ and Alunex® in whole human blood in vitro: acoustic pressure, ultrasound frequency, donor and passive cavitation detection considerations. M.W. Miller, **E. Carr Everbach**, C. Cox, R.R. Knapp, A.A. Brayman, and T.A. Sherman, *Ultrasound in Med. & Biol.* 27(5), 709-721 (2001).

Myocardial cavitation activity during continuous infusion and bolus intravenous injections of perfluorocarbon-containing microbubbles. T.R. Porter, **E. Carr Everbach**, D. Kricsfeld, and F. Xie, *Journal of the American Society of Echocardiography* 14(6):618-625:2001.

Cavitation mechanisms in ultrasound-accelerated thrombolysis at 1 MHz. **E. Carr Everbach** and Charles W. Francis, *Ultrasound in Med. & Biol.* 26(7), 1153-1160 (2000).

Bacterial stress responses to 1 MHz pulsed ultrasound in the presence of microbubbles. Vollmer, A.C., Kwayke, S., Halpern, M. and **Everbach, E. C.**, *Appl. Environ. Microbiol* 64(10), 3927-3931 (1998).

Effect of acoustic cavitation on platelets in the presence of an echo-contrast agent. **E. Carr Everbach**, I.R.S. Makin, C. Francis, and R. Meltzer, *Ultrasound in Med. & Biol.* 24(1), 129-136 (1998).

Encyclopedia article: *Ultrasound, Physical Effects of*, **E. Carr Everbach** in Encyclopedia of Applied Physics, G. Trigg, ed., Wiley-VCH publ., NY (1998), ISBN 3-527-29475-9.

Correlation of ultrasound-induced hemolysis with cavitation detector output in vitro. **E. Carr Everbach**, I.R.S. Makin, M. Azadniv, and R. Meltzer, *Ultrasound in Med. & Biol.* 23(4); 619-624 (1997).

Book Chapter: *Parameters of Nonlinearity of Acoustic Media*, **E. Carr Everbach** in Encyclopedia of Acoustics, Malcolm J. Crocker, ed., John Wiley & Sons, NY (1997), ISBN 0-471-17767-9.

Measurement of pressure and assessment of cavitation for a 22.5 kHz intra-arterial angioplasty device. I.R.S. Makin and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 100(3); 1855-1864 (1996).

An interferometric technique for B/A measurement. **E. Carr Everbach** and R.E. Apfel, *J. Acoust. Soc. Am.* 98(6); 3428-3438 (1995).

Effect of a stabilized microbubble echo contrast agent on hemolysis of human erythrocytes exposed to high intensity pulsed ultrasound. Brayman, A.A, Azadniv, M., Makin, I.R.S., Miller, M.W., Carstensen, E.L., Child, S.Z. Raeman, C.H., Meltzer, R.S., and **Everbach, E.C.**, *Echocardiography* 12(1), 13-21 (1995).

Endoscopic measurement of lesion size: improved accuracy with image processing. N. Vakil, W. Smith, K. Bourgeois, **E. Carr Everbach**, K. Knyrim, *Gastrointestinal Endoscopy* 40, Number 2, Part 1; 178-183 (1994).

Transient acoustic cavitation causes gallstone fragmentation: a study of gallstones fragmented in vivo. N. Vakil, and **E. Carr Everbach**, *Ultrasound in Med. & Biol.* 19(4); 331-342 (1993).

Internal stress wave measurements in solids subjected to lithotripter pulses. S.M. Gracewski, G. Dahake, Z. Ding, S.J. Burns, and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 94(3), 652-61 (1993).

Gallstone movement during lithotripsy: mechanisms and effects on fragmentation. N. Vakil, **E. Carr Everbach** and S.M. Gracewski, *J. Ultrasound in Med.* 11:419-424, 1992.

Microhardness properties of human gallstones and synthetic stones. S.M. Gracewski, Nimish Vakil, **E. Carr Everbach**, Mark E. Davis, and S.J. Burns, *J. Material Sci. Lett.* 11, 554-557 (1992).

Applications of mixture laws for predicting the compositions of tissue phantoms. P. Jiang, **E. Carr Everbach**, and R.E. Apfel, *Ultrasound in Med. and Biol.* 17(8), 829-838 (1991).

Therapeutic cardiac ultrasound. R.S. Meltzer, K.Q. Schwarz, J.G. Mottley, and **E.C. Everbach**, *Am. Journ. of Cardiol.* 67, 422-424 (1991).

Gas in gallstones: quantitative determinations and possible effects on fragmentation by shock waves. Nimish Vakil and **E. Carr Everbach**, *Gastroenterology* 101, 1628-1634 (1991).

Book chapter: *The appreciation of colour in endoscopy*. Nimish Vakil, Klaus Knyrim, and **E. Carr Everbach**, *Baillière's Clinical Gastroenterology*, Vol. 5, No. 1, London, March 1991. ISBN 0-7020-1529-6.

Relationship of Model Stone Properties to Fragmentation Mechanisms during Lithotripsy.

N.Vakil, S.M. Gracewski, and **E. Carr Everbach**, *J. Lithotripsy & Stone Disease* 3(4), 1-8, (1991).

A Corrected Mixture Law for B/A. **Erich Carr Everbach**, Zhe-ming Zhu, Peng Jiang, Boa Teh Chu, Robert E. Apfel, *J. Acoust. Soc. Am.*, **89**(1), 446-447 (1991).

Unrefereed Publications

Biomedical Ultrasound – Past, Present, and Future. **E. Carr Everbach**, cover article for Echoes, the newsletter of the Acoustical Society of America, Winter, 2006.
<http://asa.aip.org/winter2006.pdf>

Sono et Gravitus - The Legacy of Robert Edmund Apfel. Christy Holland and **E. Carr Everbach**, *Acoustics Research Letters Online, ARLO* 6(3), i-iii (July 2005). <http://scitation.aip.org/ARLO/>

Teaching computing to engineering freshmen through a "high-tech tools and toys laboratory." S.W. McKnight, W.E. Cole, G. Tadmor, M.F. Ruane and **E. Carr Everbach**, *Proc. of ASEE 2001*. Paper presented at meeting of the ASEE in Albuquerque, NM, June 2001..

Networking to advance undergraduate research in engineering and achieve more balanced EC2000 outcomes. F.L. Orthleib, L.A. Molter, and **E. Carr Everbach**, *Proc. of ASEE 2001*. Paper presented at meeting of the ASEE in Albuquerque, NM, June 2001.

Wide-bandwidth PVDF lithotripsy hydrophone. **E. Carr Everbach**. *ASEE 1996 Ann. Conf. Proc.* paper 1659. Poster/paper presented at the ASEE annual conference in Washington, D.C., June 1996.

Book chapter: *Image Processing in Electronic Endoscopy*. Nimish Vakil and **E. Carr Everbach**, *Clinical Gastroenterology*, Vol. 2, No. 1, Gordon and Breach, London 1996.

Light from Sound. **E. Carr Everbach**, cover article for Echoes, the newsletter of the Acoustical Society of America, April 1993.

Letter to the Editor. Nimish Vakil, **E. Carr Everbach**, Klaus Knyrim, *New England Journal of Medicine*, May 1993.

Report of the 22nd Hunt Fellow of the Acoustical Society of America. **E.C. Everbach**, *J. Acoust. Soc. Am.*, June 1991, Forum Section.

Using the Acoustic Nonlinearity Parameter for Tissue Composition Prediction. Robert E. Apfel and **E. Carr Everbach**, *Proc. Intrntl. Conf. on Acoust.*, Vol. 4, pp. 167–170. (August 22–31, 1989). Paper presented at the 13th I.C.A. in Belgrade, Yugoslavia.

Abstracts of Papers Presented

Ultrasonic method for monitoring muscle water content, CH McLeish, SN Tsyuryupa, AP Sarvazyan, and EC Everbach, *IEEE UFFC 4C-6*, September 4, 2017, Washington, DC, presented by the student.

Sonothrombolysis of porcine blood clots using 1 MHz pulsed ultrasound. Nourmahnad, Atousa; Barbano, Luke; and **Everbach, Erich C.**, *J. Acoust. Soc. Am.* 136(3):1825. Poster presented at the 169th meeting of the Acoustical Society of America in Jacksonville, FL, November 4, 2015, by the students.

Modeling of microbubbles pushed through clots via acoustic radiation force. Ascanio Guarini and **E.C. Everbach**, *J. Acoust. Soc. Am.* 133(5):3356. Paper presented at the 165th meeting of the Acoustical Society of America and ICA in Montreal, Canada, June 5, 2013, by the student.

Tracking the motion of cavitation bubbles using pulsed Doppler. **E.C. Everbach, J.** *Acoust. Soc. Am.* 132(3):1907. Paper presented at the 164th meeting of the Acoustical Society of America in Kansas City, MO, October 25, 2012.

Cavitation activity in bacterial biofilms exposed to 1 MHz ultrasound. **E. Carr Everbach**, Roby Velez, and Amy C. Vollmer, *J. Acoust. Soc. Am.* 123(5):3557. Paper presented at the 155th meeting of the Acoustical Society of America in Paris, France, July 3, 2008.

Effect of 810 kHz cw ultrasound on bacterial biofilms. Kofi Anguah, Roby Velez, Amy C. Vollmer, and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 122(5):3052. Paper presented at the 154th meeting of the Acoustical Society of America in New Orleans, LA, November 30, 2007, by the students.

A possible noncavitation mechanism of ultrasound-accelerated thrombolysis in fibrin clots. **E. Carr Everbach**, *J. Acoust. Soc. Am.* 119(5):3406. Paper presented at the 151st meeting of the Acoustical Society of America in Providence, RI, June 8, 2006.

Use of ultrasound as educational tool in medicine. **E. Carr Everbach**, *J. Acoust. Soc. Am.* 119(5):3381. Paper presented at the 151st meeting of the Acoustical Society of America in Providence, RI, June 7, 2006.

Wavelet analysis of active cavitation detector output. Kofi Anguah and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 119(5):3322. Paper presented at the 151st meeting of the Acoustical Society of America in Providence, RI, June 7, 2006 by the student.

Tutorial Lecture: Diagnostic Imaging in Biomedical Ultrasound. **E. Carr Everbach**, *J. Acoust. Soc. Am.* 118(3):1877. Prestigious lecture presented at the 150th meeting of the Acoustical Society of America in Minneapolis, MN, October 17, 2005.

Hot Topics in Acoustics: Biomedical Ultrasound. **E. Carr Everbach**, *J. Acoust. Soc. Am.* 118(3):1972. Paper presented at the 150th meeting of the Acoustical Society of America in Minneapolis, MN, October 17, 2005.

Confocal microscopy movies of fibrin clots during ultrasound-accelerated thrombolysis. **E. Carr Everbach**, I.N. Chernysh, J.W. Weisel, *J. Acoust. Soc. Am.* 117(4):2413. Paper presented at the 149th meeting of the Acoustical Society of America in Vancouver, BC, May 2005.

Active cavitation detection of asymmetrical inertial cavitation. **E. Carr Everbach**, *J. Acoust. Soc. Am.* 115(5):2514. Paper presented at the 147th meeting of the Acoustical Society of America, 75th Anniversary, New York, NY, May 2004.

ASA Education in Acoustics website as a new portal. **E Carr Everbach**, J. Acoust. Soc. Am. 114(4): 2309. Paper presented at the 146th meeting of the Acoustical Society of America in Austin, TX, November 2003.

Acoustics Demonstrations. **E Carr Everbach**, J. Acoust. Soc. Am. 113(4): 2240. Demos presented at the 145th meeting of the Acoustical Society of America in Nashville, TN, April 2003.

ASA education outreach. Uwe Hansen and **E Carr Everbach**, J. Acoust. Soc. Am. 113(4): 2267. Paper presented at the 145th meeting of the Acoustical Society of America in Nashville, TN, April 2003.

Differences in Definity and Optison Microbubble Destruction Rates at the Same Mechanical Index with Different Real Time Perfusion Systems, T R Porter, F Xie, J Oberdorfer, **E Carr Everbach**, P Rafter, L Venneri, C Sonme, ASE 2003 Annual Meeting. Paper presented at the 2003 ASE meeting in Toronto, Canada.

30 MHz backscatter and Doppler signals from individual microbubbles undergoing inertial cavitation. Johanna Yoon '02 and **E. Carr Everbach**, J. Acoust. Soc. Am. 111(5): 2002. Paper presented at the 143th meeting of the Acoustical Society of America in Pittsburgh, PA, June 2002.

Quantification of sub-micron DDFP gas bubbles using 30 MHz ultrasound backscattered tonebursts. **E. Carr Everbach**, R.A. Roy, and J. Flaherty, J. Acoust. Soc. Am. 110(5): 2001. Paper presented at the 141th meeting of the Acoustical Society of America in Ft. Lauderdale, FL, December 2001.

Srotonin receptor blockade by NAN-190 enhances memory modulation. A.M. Schneider, E. Wilkins, A. Firestone, M. Choy, D. Levin, **C. Everbach**, P.E. Simson, J.C. Naylor, K.R. Short; Neurosciences, Nov. 2001.

In vitro study of mechanisms of transient response imaging. Suor Kim '02 and **E. Carr Everbach**, J. Acoust. Soc. Am. 107(6):2198, 2000. Paper presented at the 139th meeting of the Acoustical Society of America in Atlanta, GA, by the student, May 30, 2000.

Parameter dependence of 20-MHz passive inertial cavitation detector output. Alyssa Bonnoit '03 and **E. Carr Everbach**, J. Acoust. Soc. Am. 107(6):2198, 2000. Paper presented at the 139th meeting of the Acoustical Society of America in Atlanta, GA, by the student, May 30, 2000.

Interdisciplinary Undergraduate Research at Small Colleges, **E. Carr Everbach**. Keynote speaker at first undergraduate research symposium, Albright College, April 15, 2000.

Bacterial stress response due to acoustic cavitation. Annie Willman '01, **E. Carr Everbach**, and Amy C. Vollmer, J. Acoust. Soc. Am. 106(4):2198, 1999. Paper presented at the 138th meeting of the Acoustical Society of America in Columbus, OH, by the student, Nov. 3, 1999.

Teaching science/engineering students about gender issues in science and technology. **E. Carr Everbach** and members of the Tri-College Gender-in-Science discussion group,

Greater Philadelphia Women's Studies Consortium meeting, West Chester University (West Chester, PA), May 7, 1999.

Enhancement of fibrinolysis by low-intensity c.w. ultrasound. Charles W. Francis, Valentina Suchkova, and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 105(2):1369, 1999. Paper presented at the 137th meeting of the Acoustical Society of America, joint meeting with the European Acoustics Association and German Acoustics DEGA, in Berlin, Germany, March 15-19, 1999.

An Investigation of the Effects of Ultrasound Exposure on Escherichia coli Using a Bioluminescent Reporter System. Halpern, M., Kwakye, S., **Everbach, E. C.**, and Vollmer, A.C., in Abstracts of the 98th General Meeting of the American Society for Microbiology, A-98, p.55. American Society for Microbiology, Washington, D.C., May 1998.

Acoustic detection of microbubble destruction in gaseous contrast agents. William T. Shi, Flemming Forsberg, and **E. Carr Everbach**, *J. Acoust. Soc. Am.* 103(5):3002, 1998. Paper presented at the 135th meeting of the Acoustical Society of America, joint meeting with the 16th International Congress on Acoustics, in Seattle, WA, June 25, 1998.

Overpressure reduces acceleration of thrombolysis due to ultrasound. **E. Carr Everbach**, Janice White, and Charles W. Francis, *J. Acoust. Soc. Am.* 102(5): 3154 (1997). Paper presented at the 134th meeting of the Acoustical Society of America, in San Diego, CA, December 4, 1997.

Bubble collapse emissions suggest mechanism for transient response imaging. **E. Carr Everbach**, Shouping Li, and Thomas R. Porter, *J. Acoust. Soc. Am.* 102(5): 3154 (1997). Paper presented at the 134th meeting of the Acoustical Society of America, in San Diego, CA, December 4, 1997.

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Field measurements for an intra-arterial angioplasty device. Inder Raj S. Makin and **E. Carr Everbach**, J. Acoust. Soc. Am. 95(5), Part 2; 2855 (1994). Paper presented at the 127th meeting of the Acoustical Society of America in Cambridge, MA.

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Quantitative Determinations of Gas in Human Gallstones. Nimish Vakil and **E. Carr Everbach**, Gastroenterology, Vol. 98, No. 5, Part 2, A641 (1990). Poster presented at May 1990 meeting, San Antonio, TX.

Mixture Composition Determination from Measurements of the Acoustic Nonlinearity Parameter. **E.C. Everbach** and R.E. Apfel, J. Acoust. Soc. Am. S1 (85), S151 (Spring 1989). Paper presented at 117th meeting of the Acoustical Society of America in Syracuse, NY.

Application of the Acoustic Nonlinearity Parameter to Tissue Composition Prediction. Robert E. Apfel and **E.C. Everbach**, J. Acoust. Soc. Am. S1 (84), S138 (Fall 1988). Paper presented at 116th meeting of the Acoustical Society of America in Honolulu, HI.

Enhanced Nonlinearity in a Bubbly Liquid considered as a Mixture. **E.C. Everbach** and R.E. Apfel, J. Acoust. Soc. Am. S1 (83), S109 (Spring 1988). Paper presented at 115th meeting of the Acoustical Society of America in Seattle, WA. <http://doi.org/10.1121/1.2025126>

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The Nonpropagating Hydrodynamic Soliton in Annular Geometries. E.C. Everbach and R.E. Apfel, J. Acoust. Soc. Am. S1 (79), S32 (Spring 1986). Paper presented at 111th meeting of the Acoustical Society of America in Cleveland, OH.

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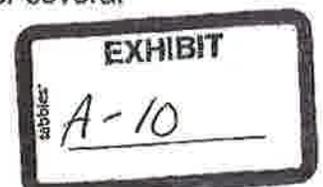
Re: Conditional Use Application, Oak Lane Projects at Westtown School

Dear John:

This letter constitutes my report of acoustical measurements I made on the property of Westtown School on Tuesday, February 6, 2019, at your request. The purpose of the measurements was to assess the likelihood that noise from athletic practices on the proposed Oak Lane fields would exceed the noise ordinances for nearest property-holders to the fields. In my experience of measuring and modeling outdoor noise propagation over 30 years, I have rarely examined a situation less likely to exceed noise ordinances than this one, because of the large distances involved.

I would like to highlight a few scientific facts regarding outdoor sound propagation. First, with distances of sound source and receiver (or measurer) fixed, and atmospheric conditions unchanged, the sound level measured in decibels (dB) is a strict function of source level in dB. Put another way, if the source is 10 dB louder, then the receiver will be 10 dB louder, too. Second, the reduction of sound level with distance is due to the spherical spreading out of the sound from the source: the same acoustic energy that was emitted is spread out on a larger and larger sphere until it reaches the receiver. The rule for free-field (i.e. no reflections or focusing from buildings) sound propagation is a 6 dB reduction per doubling of distance between source and receiver. This number will become important because the distances between the sound source (athletic practice on a turf field) and nearest properties represent many doublings of distance and many 6 dB reductions from the source level.

Published data on the noise of unamplified athletic practice fields shows maximum source levels in the range 80 - 85 dB(A), where the A-weighting is a sound level meter setting that mimics the frequency response of the human ear. To compare these average data with measurement, I stood 10 feet away from Paul Lehmann on the site of the proposed field as he blew his coach's whistle, measuring the sound pressure using my calibrated Bruel & Kjaer 2270 Sound Level meter. Average values over several



loud blasts were 80.3 dB(A) with the largest being 84.2 dB(A). Since sound source levels add logarithmically, if there had been two whistles blowing simultaneously, the combined source pressure would be 3 dB larger, or an average of 83.3 dB(A). This would also be true if children were yelling on the field with a combined sound level of 80 dB(A). Thus we can assume that the source pressure levels are likely to be in the range 80 – 85 dB(A), consistent with published data.

To measure the propagation of sound to distant points, I used a calibrated noise source: a battery-powered “boom box” producing white noise (hiss) in 10-second bursts with 5-second silences in between. This noise source was placed first on a location near home plate (position “A”) at the proposed site and measurement points were selected at various distances in the direction of the homes on Station Way. The noise source level was 85 dB(A) at 10 feet. Figure 1 shows the locations of the measurement points (recorded via GPS) and Figure 2 shows a wider view with distances to the Station Way circle marked.

Similarly, I set the noise source on the corner of the playing field (position “B”) closest to Shady Grove Way and Thrush Lane. I then measured the sound at location points shown in Figures 3 and 4. Since the noise source was producing white noise in 10-second pulses, it was possible to measure both the sound level and the background noise at each point. Ambient noise included traffic on Street Road, Shady Grove Way, and Westtown Road, airplane overflights, and natural noise sources such as Canada geese honking.

Table 1 below shows the results of the measurements. It is clear that for distances beyond about 350 feet for source location A, and 220 feet for source location B, that the background noise exceeded the noise signal, rendering it inaudible and unmeasurable. Nevertheless, the distances to both Station Way circle (2397 feet from Source A) and Shady Grove Way (1398 feet from Source B), are much farther than the inaudible measurement locations, indeed more than three distance doublings. With spherical spreading of sound, these distant locations would result in sound levels 18 decibels lower (6 dB for each doubling).

The only numerical noise regulations in the Westtown Township code I could find are described in this paragraph. The first relates to traffic noise along Route 202: [§ 149-929](#) Noise Protection, in which section B.2.a reads in part: “...A noise nuisance shall be defined as a sound level at any proposed residential building footprint of greater than 62 dB(A) Ldn in sound level. The sound level shall be measured at times between 3:30 p.m. and 6:00 p.m.” In a section related to transmission pipelines, the Westtown Township codes includes this numerical noise standard in [§ 170-1612](#) subsection A.3.c: “sound produced by the surface land use affiliated with transmission pipelines shall not result in noise or vibration clearly exceeding the average intensity of noise or vibration occurring from other causes at the property line; in no case shall the sound pressure level exceed 60 dB(A) [according to the American National Standards Institute (ANSI) “a” weighted scale] at the property line closest to the land use.” Finally, Article XV, § 170-1515, section D.1 reads “... there shall be no ... commercial or industrial operations or any truck loading or unloading activities that create a noise level exceeding 55 A-weighted decibels at the exterior walls of any dwelling.” It is clear from

these codes that 55-62 dB(A) is the sound pressure level range of concern, and yet the levels that would be produced by athletic practice at the proposed site would be tens of decibels lower.

Position	Longitude	Latitude	signal	background	dist(ft)
G7	39.94418879578905	-75.53742637565308	SourceA		0
G8	39.94417978629636,	-75.53742630515998	78.7	41.4	10
G9	39.94383845625965	-75.53720123087193	52.0	41.5	136
G10	39.94333891746662	-75.53806352139142	43.6	42.0	350
G11	39.94263975958271	-75.53728549822036	<41	42.3	570
G12	39.94212019035976	-75.53663765038357	<41	41.9	664
G13	39.945320889718154	-75.53615931165307	82.0	41.5	10
G14	39.94547556634625	-75.53583275853723	52.8	43.2	100
G15	39.945702101728614	-75.53555358730915	<44	44.1	220
G16	39.94621349101601	-75.5340709306482	<42	42.4	650
G17	39.94599510531278	-75.53453746541416	<41	41.9	518
G18	39.93776441321611	-75.539447799544	<50	50.4	2397
G19	39.9471303726783	-75.5319612783473		51.7	1398

Table 1: Summary of measured noise levels at locations marked in Figures 1 through 4.

To illustrate the point that spherical spreading of sound from the proposed site would render noise levels far below ambient at the nearest residential lot lines, Table 2 shows the 6-dB reduction per doubling of distance rule, with a source level of 85 dB(A) and a background noise level of 41 dB(A). From Table 2 one can see that the noise level at properties farther than about 160 feet would be below 61 dB(A), and those farther than 1000 feet from the source would be at or below background. Since the nearest residence lot lines are farther than 1000 feet, it follows that athletic practice sounds should be inaudible there.

Distance from Source (ft)	Sound Pressure Level dB(A)	dB above background
10	85	44
20	79	38
40	73	32
80	67	26
160	61	20
320	55	14
640	49	8
1280	43	2
2560	37	-4

Table 2: Estimated Sound Pressure Levels at various distances from the Source due to Spherical Spreading of Sound Waves

In summary, I have conducted outdoor measurements of noise propagation on the proposed Oak Lane Projects at Westtown School, and have determined that there is negligible chance that noise from athletic practice sessions will produce sound levels above background noise levels at the nearest property lot lines.

Do not hesitate to contact me if you have questions.

Sincerely,



E. Carr Everbach
 Consultant in Acoustics since 1986

Appendix A: Applicable American National Standards Institute standards adhered to in the conduct of this work.

ANSI S1.4-1983 (R2006) Specification for Sound Level Meters

ANSI S1.40-2006 Specifications and Verification Procedures for Sound Calibrators

ANSI S1.43-1997 (R2007) Specifications for Integrating-Averaging Sound Level Meters

ANSI S1.11-1966 Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets

ANSI S1.11-2004 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

ANSI S12.9-2005 Quantities and Procedures for Description and Measurement of Environmental Sound

ANSI S12.9-2005/Part 4: Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response

ANSI S12.9-2007/Part 5: Sound Level Descriptors for Determination of Compatible Land Use

ANSI S1.17-2004/Part 1 Microphone Windscreens – Part 1: Measurements and Specification of Insertion Loss in Still or Slightly Moving Air

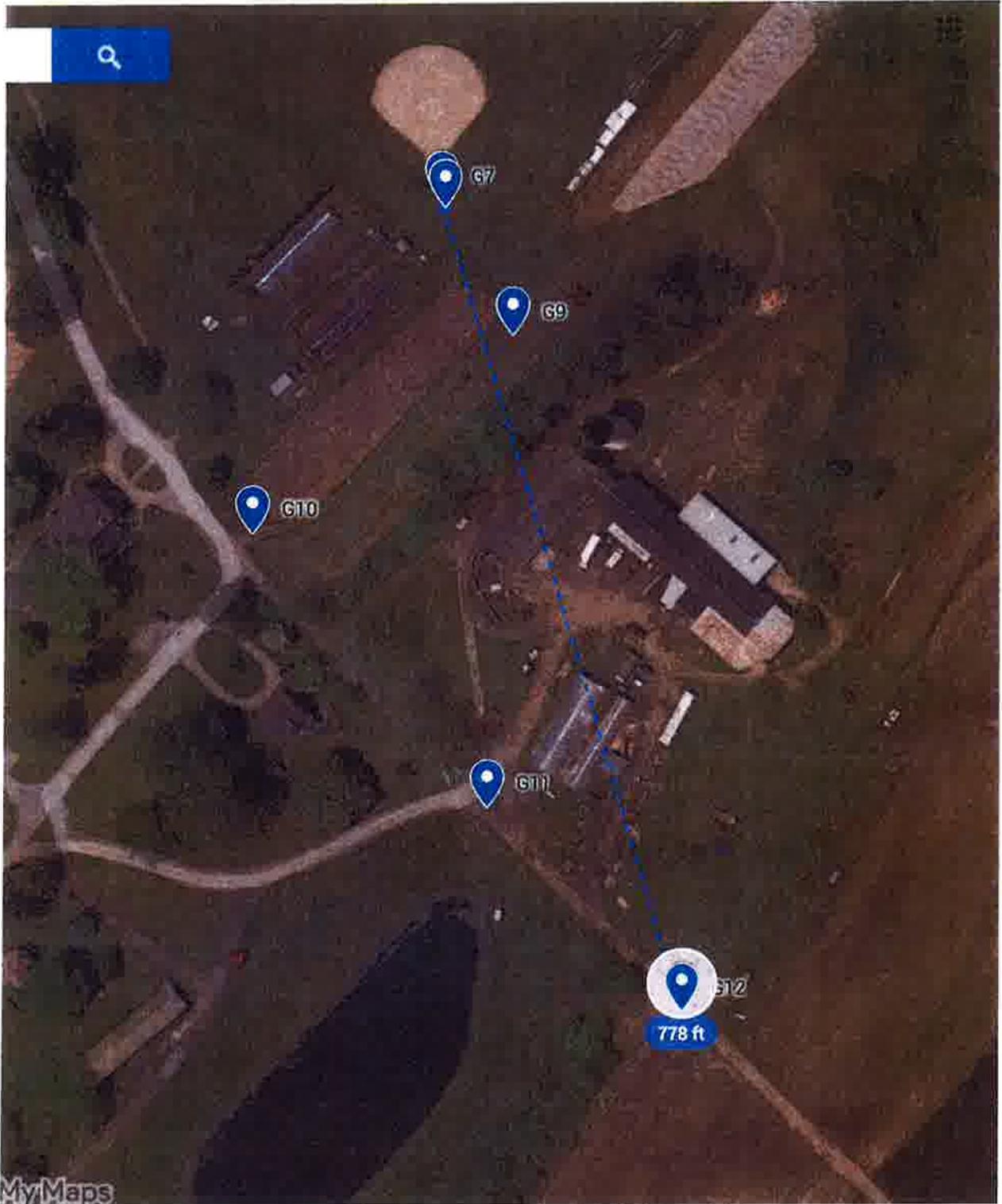


Figure 1: Acoustic Monitoring Locations for Noise Source A

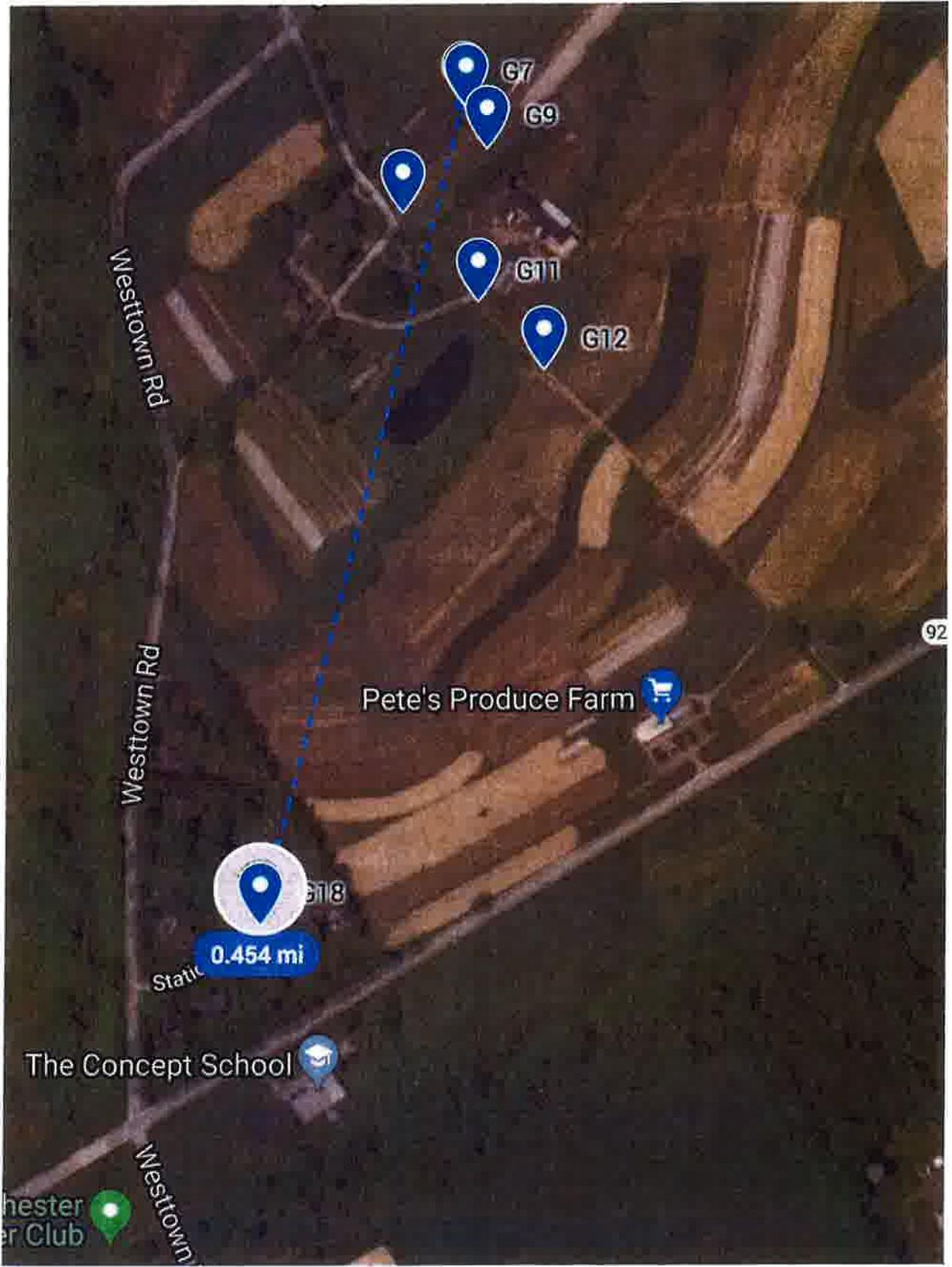


Figure 2: Acoustic Monitoring Locations for Noise Source A showing distance to center of Station Way circle.

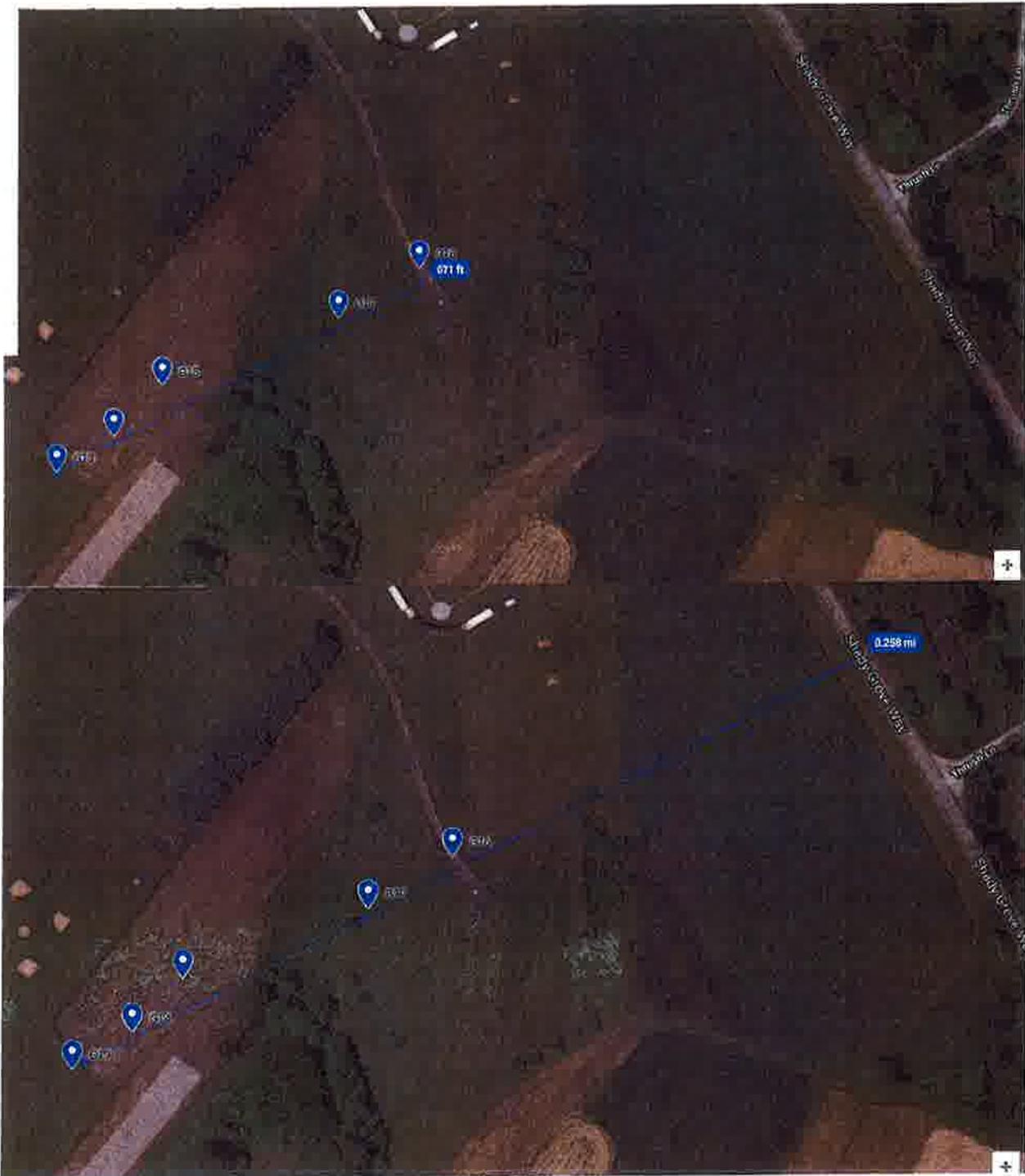


Figure 3: Acoustic monitoring locations for Noise Source B.



Figure 4: Acoustic monitoring locations for Noise Source B showing distance to nearest property boundaries on Shady Grove Way.

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International Dark-Sky Association (IDA)

With over 25 years experience in the lighting industry, Bob has been directly involved in well over 3,000 sports lighting projects ranging from neighborhood Little League fields to Minor League Baseball Stadiums. He regularly provides lighting designs and is a technical support to over 100 Professional Engineering Firms in the Northeast Region of the United States including Maryland, Delaware, Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, and Maine. Bob has provided expert testimony as well as information and work sessions before Zoning, Planning, School, and Supervisory Boards in a number of states regarding sports lighting projects. He has been an invited speaker providing technical instruction at seminars and workshops for engineering firms and organizations including local IESNA Chapters.

Places Where Expert Testimony Was Presented: *

Portland, Maine – Planning/Zoning Board

Wentham, Massachusetts – Planning/Zoning Board
Williamstown, Massachusetts – Planning/Zoning Board
Winchester, Massachusetts - Planning/Zoning Board

Anne Arundel County, Maryland – Planning Board
Montgomery County, Maryland – Planning Board
Queen Anne County, Maryland – Planning/Zoning Board

Hanover, New Hampshire – Planning Board (multiple projects)
Salem, New Hampshire – Salem Superior Court

Allendale, New Jersey – Planning Board
Basking Ridge, New Jersey – Township Council
Berkley Heights, New Jersey - Planning Board (multiple projects)
Blairstown, New Jersey – Planning Board
Bernardsville, New Jersey -- Zoning Board
Elmwood Park, New Jersey – Planning Board
Flemington, New Jersey – Planning Board (multiple projects)



Florham Park, New Jersey -- Zoning Board
Haddonfield, New Jersey -- Planning/Zoning Board
Hamilton Township, New Jersey - Planning Board
Hoboken, New Jersey -- Planning/Zoning Board
Hopewell Township, New Jersey -- Planning Board
Lawrenceville, New Jersey -- (multiple projects) Planning Board
Leonia, New Jersey -- Planning Board
Madison, New Jersey -- Planning Board
Mahwah, New Jersey -- Planning Board (multiple projects)
Millstone, New Jersey -- Planning Board
Montvale, New Jersey -- Planning/Zoning Board (multiple projects)
Mount Olive, New Jersey -- Planning/Zoning Board
Oradell, New Jersey -- Zoning Board (multiple projects)
Pennington Borough -- Planning Board
Pequannock, New Jersey -- Zoning Board
Plainsboro, New Jersey -- Zoning Board
Pompton Lakes, New Jersey -- Zoning Board
Randolph Township, New Jersey -- Zoning Board
Raritan, New Jersey -- Planning/Zoning Board
Red Bank, New Jersey -- Planning/Zoning Board
Ridgewood, New Jersey -- Planning Board
Rockaway, New Jersey - Planning Board
Roseland, New Jersey -- Planning Board (multiple projects)
Rumson, New Jersey -- Town Council
South Orange, New Jersey -- Planning Board (multiple projects)
South River, New Jersey -- Planning/Zoning Board
Tinton Falls, New Jersey - Planning Board
Toms River Township, New Jersey -- Zoning Board of Adjustment
Upper Township, New Jersey -- Planning/Zoning Board
Verona, New Jersey - Planning/Zoning Board
West Long Branch, New Jersey -- Planning/Zoning Board
West Milford, New Jersey -- Planning Board
West Windsor Township, New Jersey -- Planning Board
Wyckoff Township, New Jersey -- Planning Board

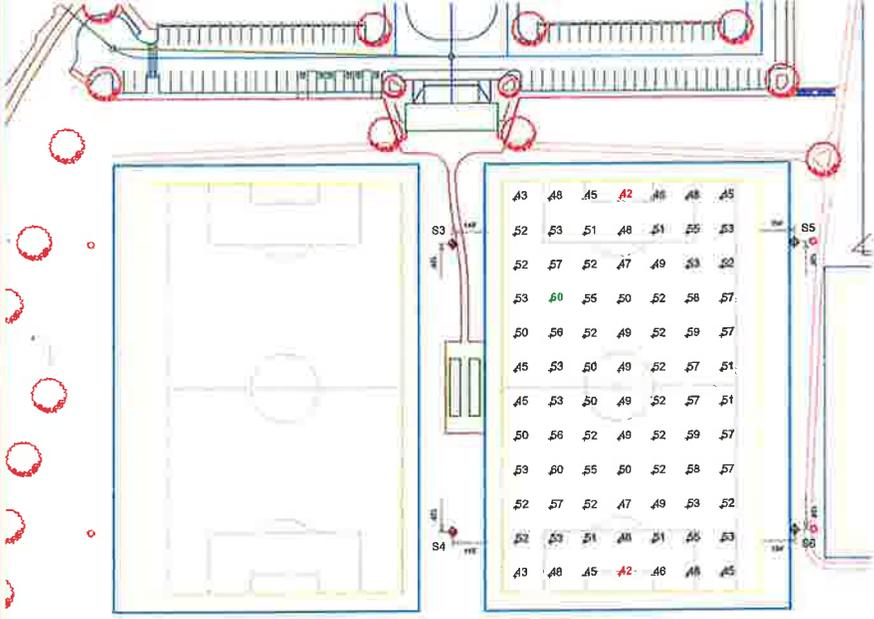
Downington, Pennsylvania - Zoning Board
Doylestown, Pennsylvania -- Board of Supervisors
East Bradford, Pennsylvania -- Zoning Board
East Hill, Pennsylvania -- Zoning Board
Easton, Pennsylvania -- Zoning Board
East Hempfield Township, Pennsylvania -- Zoning Board
East Vincent Township, Pennsylvania -- Zoning Board
Glenburn, Pennsylvania -- Zoning Board
Hellertown, Pennsylvania -- Zoning Board
Kingston, Pennsylvania -- Zoning/Planning/Town Council
Lehighton, Pennsylvania -- Zoning Board

Lower Gwynedd Township, Pennsylvania – Zoning Board
Lower Makefield Township, Pennsylvania – Planning Commission
Monaghan Township, Pennsylvania – Board of Supervisors
Oley Valley, Pennsylvania - Planning/Zoning/Historic Commission
Scranton, Pennsylvania – Zoning Board
Springfield, Pennsylvania (Delaware County) – Council, Planning Bd./Zoning Bd
Springfield, Pennsylvania (Montgomery County) Zoning Board
Upper Merion Township (Valley Forge), Pennsylvania – Planning Board
West Goshen Township – Board of Supervisors
West Grove, Pennsylvania – Zoning Board
Worcester Township, Pennsylvania - Board of Supervisors

** Planning/Zoning/Supervisor's Boards where qualifications were not required but testimony/information has been publicly presented have not been included in this list.*

APP	DESCRIPTION	QTY	UNIT	AMOUNT	TOTAL	PRICE	TOTAL
1	35-24	80	LF	35.24	2819.20	35.24	2819.20
2	35-24	80	LF	35.24	2819.20	35.24	2819.20
3	35-24	80	LF	35.24	2819.20	35.24	2819.20
4	35-24	80	LF	35.24	2819.20	35.24	2819.20

* This structure utilizes a back-to-back mounting configuration.



SCALE IN FEET 1"=20'

ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Pole location(s) ◊ dimensions are relative to 0,0 reference point(s) ⊗

PROJECT SUMMARY	
Name:	Project 2
Size:	360' x 205'
Spacing:	30' 0" x 30' 0"
Height:	30' above grade

ILLUMINATION SUMMARY	
Guaranteed Average:	60
Scan Average:	51.92
Maximum:	60
Minimum:	42
Avg. Fld.:	1.21
Uniformity Max / Min:	8
Min / Max:	1.41
VO to Point (ft):	1.21
CU:	0.77
EW:	0.08
No. of Points:	84
Color / CRI:	5700K - 75 CRI
Luminaire Output:	121,000 lumens
No. of Luminaire:	42
Power (watt):	48.3 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-5-15.

Electrical System Requirements: Refer to Ampereage Draw Chart and/or the "Musco Control System Summary" for electrical string.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 5 feet (1m) of design locations.



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ILLUMINATION SUMMARY

EQUIPMENT LIST FOR ATTACHMENTS									
QTY	DESCRIPTION	NO.	MAKE	MODEL	DATE	UNIT	PRICE	TOTAL	REMARKS
1	1553	20'	BY	BY	11/15/10	11	11	0	
1	2054	20'	BY	BY	11/15/10	11	11	0	
1	2058	20'	BY	BY	11/15/10	11	11	0	

* This structure will be a back to back mounting configuration.



SCALE: 1/4" = 1'-0"
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Pole location(s) Ⓧ dimensions are relative to 0,0 reference point(s) Ⓞ

Westtown School Soccer

West Chester, PA

PROJECT SUMMARY	
Name:	Basket Field
Spacing:	30'0" x 30'0"
Height:	1.0' above grade
ILLUMINATION SUMMARY	
Area:	9000 sq ft
Scan Average:	67.02
Minimum:	61
Maximum:	0
Avg / Min:	497020.97
Max / Min:	6482882.28
UGI (luminaire dist):	16.69
UGI (luminaire dia):	0.09
UGI (luminaire hgt):	621
Color / CRI:	1500K - 95 CRI
Luminaire Output:	121,000 lumens
No. of Luminaires:	88
Total Load:	18.6 A/W
Luminaire Type:	LED Type
LED Type:	LED Type
LED Type:	LED Type
LED Type:	LED Type

Guaranteed Performance: The ILLUMINATION described above is guaranteed per year. Musco warrants placement and includes a 0.55 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locators.

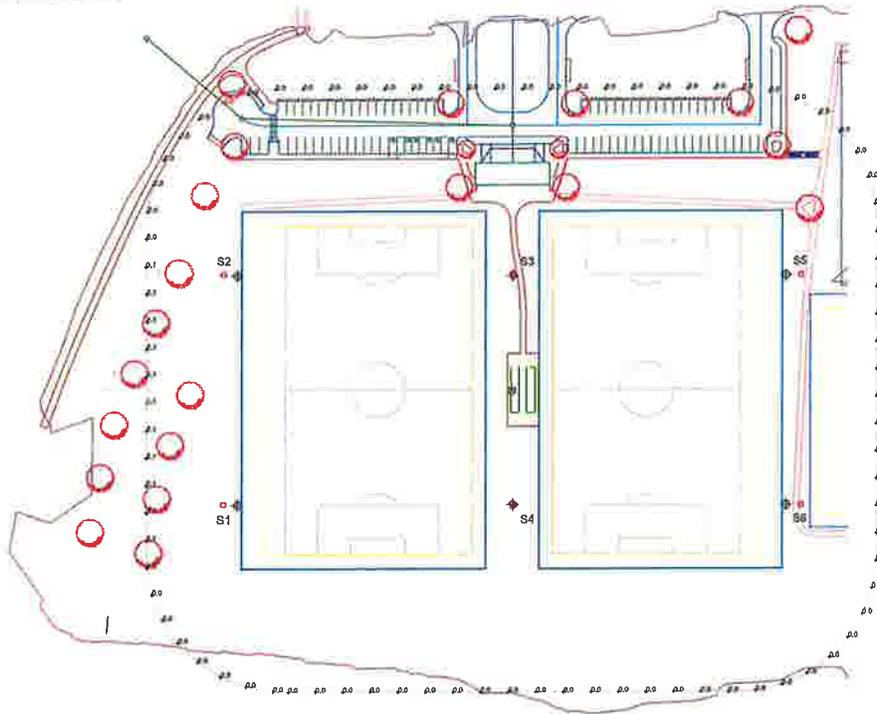


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ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREA SUMMRY									
NO.	LOCATION	NO.	TYPE	MANUFACTURER	MODEL	QTY	WATT	WATT	WATT
1	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
2	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
3	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
4	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
5	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
6	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
7	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
8	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
9	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000
10	SOFT	200	LED	MUSCO	15000-1500	10	15000	150000	150000

* This structure contains a built-in emergency lighting system.



Westtown School Soccer West Chester, PA

FIELD SUMMARY	
Field:	150' Soccer Field
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY	
ENTER GRID	
Typ. Footcandle:	8.88
Maximum:	0.12
Minimum:	0.00
No. of Fixtures:	88
Case #:	9700C-25-20
Equivalent Output:	125,000 lumens
No. of Fixtures:	88
Total Watt:	132,000 W
Wattage per Foot:	1.50 W/ft
LED lumens:	1.70 lm/W
FLUORESCENT:	181,000
LED:	181,000
LED:	181,000

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-35.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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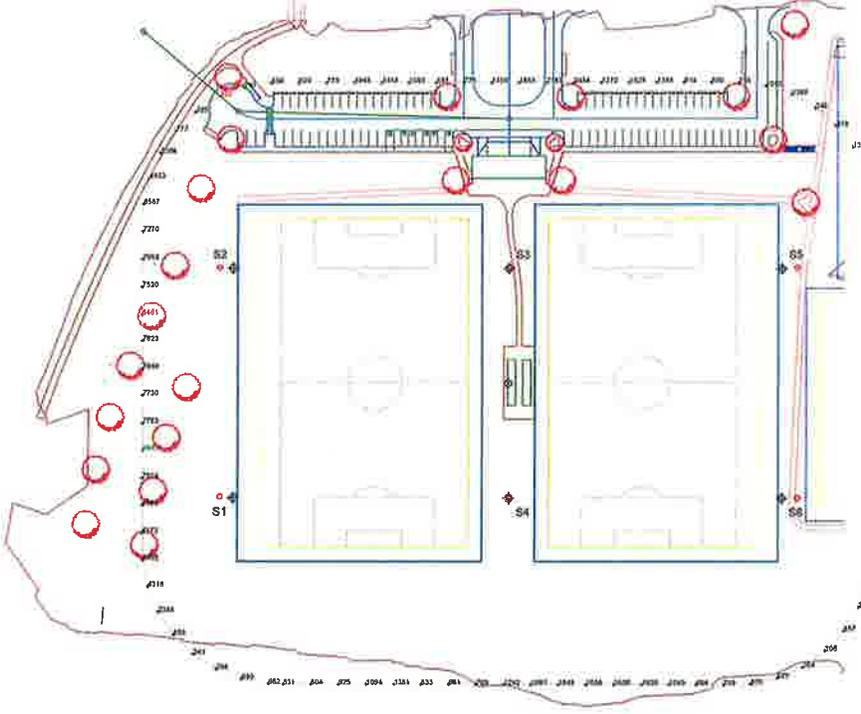
ILLUMINATION SUMMARY

SCALE: 1/4" = 1'-0"
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Field location(s) ● dimensions are relative to 0.0 reference point(s) ⊙

EQUIPMENT LIST FOR AREAS SHOWN						
NO.	DESCRIPTION	REV.	DATE	QUANTITY	AMOUNT	TOTAL
1	1000W	00	00	10	10,000	10,000
2	1500W	00	00	10	15,000	15,000
3	2000W	00	00	10	20,000	20,000
4	3000W	00	00	10	30,000	30,000
5	4000W	00	00	10	40,000	40,000
6	5000W	00	00	10	50,000	50,000
7	6000W	00	00	10	60,000	60,000
8	7000W	00	00	10	70,000	70,000
9	8000W	00	00	10	80,000	80,000
10	9000W	00	00	10	90,000	90,000

* This structure utilizes a ball-to-ball mounting configuration.



SCALE IN FEET 1 : 100
 0 100 200
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Pole location(s) Ⓢ dimensions are relative to 0.0 reference point(s) Ⓢ

Westtown School Soccer West Chester, PA

GRID SUMMARY	
Name:	EST Soccer Field
Latitude:	33.0'
Height:	2.0' above grade

ILLUMINATION SUMMARY	
Grid:	Circle Grid
Area:	5000 sq ft
Minimum:	225.88
No. of Poles:	10
Color / CRI:	5700K - 95 CRI
Luminaire Output:	101,000 lumens
No. of Luminaires:	10
Total Load:	10 x 1000W

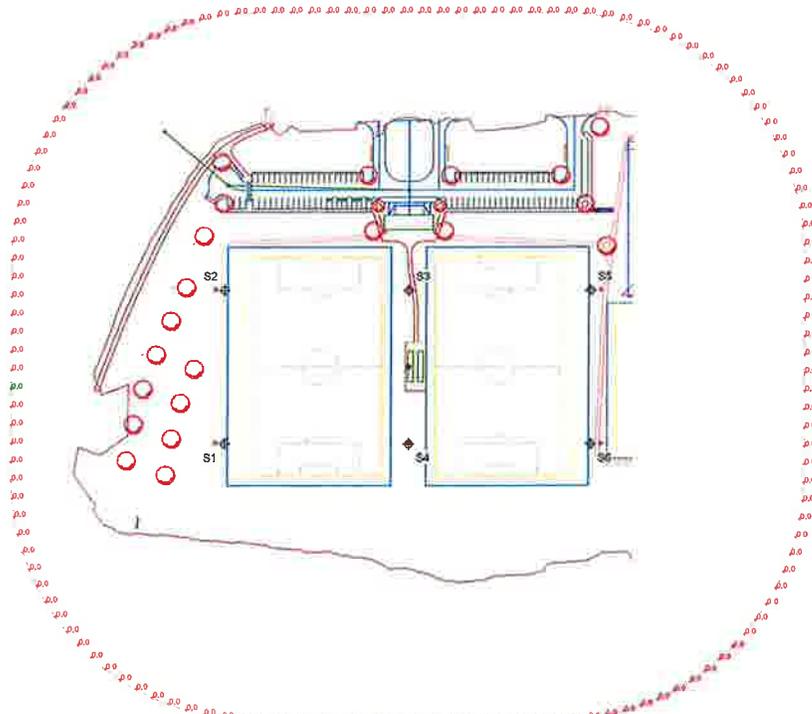
Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.
Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.
Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.
Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREAS BELOW									
QTY	LOCATION	REV	QTY	REVISION	DATE	BY	CHK	APP	STAGE
1	11-12	RF	10	10-11-12	10-11-12	VA			0
2	12-14	RF	20	12-14-12	12-14-12	VA			0
3	14-16	RF	30	14-16-12	14-16-12	VA			0
4	16-18	RF	40	16-18-12	16-18-12	VA			0

* This schedule refers to back mounting configuration



Westtown School Soccer

FIELD SUMMARY			
Name:	400' Soccer Field		
Spacing:	30' x 30'		
Height:	3.0' above grade		

ILLUMINATION SUMMARY			
Scale Average:	0.0000		
Maximum:	0.00		
Minimum:	0.00		
No. of Points:	541		
Color / CH:	3700K - T5 CH		
Luminaire Output:	121,000 lumens		
No. of Luminaires:	44		
Total Load:	76.8 kW		

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RA-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.

Installation Requirements: Results assume 2.5% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

SCALE IN FEET 1 : 100
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

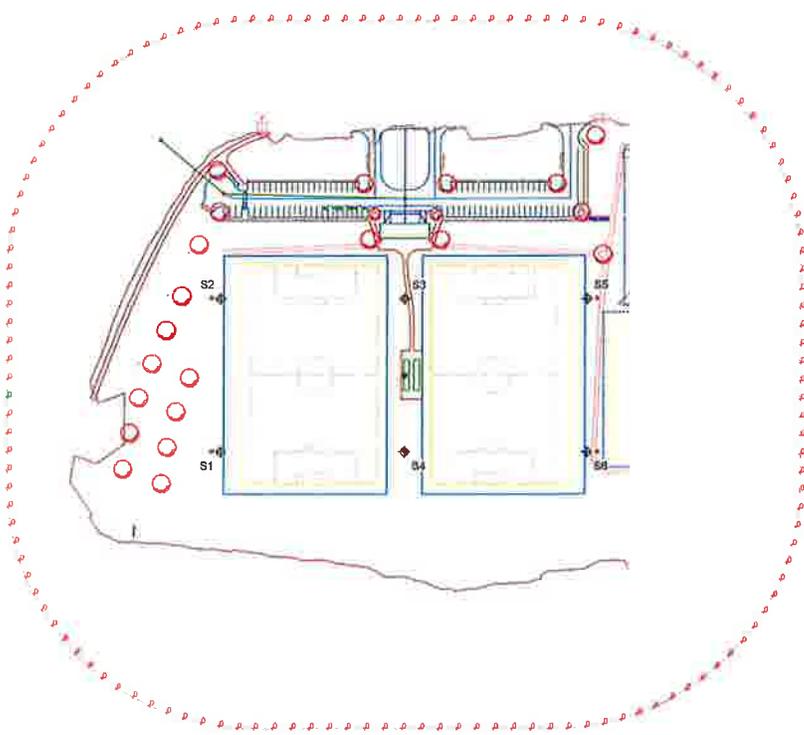
Pole location(s) are relative to 0,0 reference point(s)



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ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREAS SHOWN									
QTY	DESCRIPTION	SIZE	WATTAGE	VOLTAGE	WIRE SIZE	TYPE	WIRE	TYPE	GROUP
2	100W	30"	100	120V	14	FL	14	FL	100W
2	100W	30"	100	120V	14	FL	14	FL	100W
2	100W	30"	100	120V	14	FL	14	FL	100W
2	100W	30"	100	120V	14	FL	14	FL	100W
2	100W	30"	100	120V	14	FL	14	FL	100W



SCALE IN FEET 1 : 150
 0 150 300
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

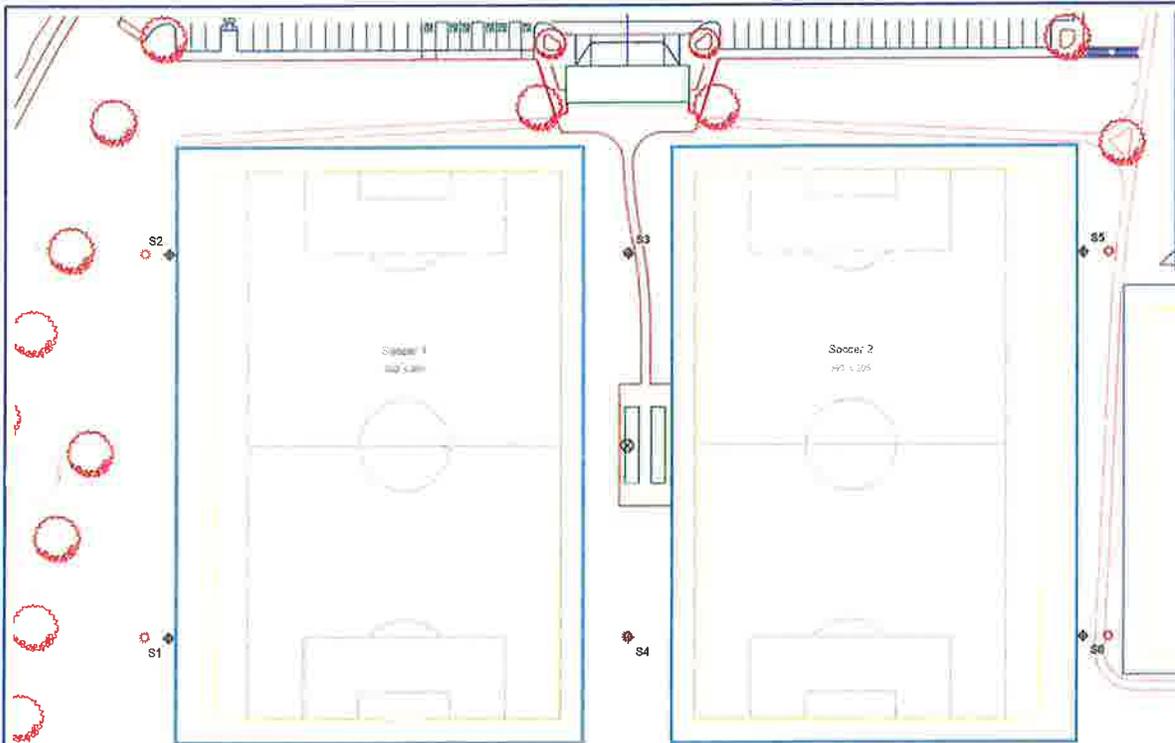
Westtown School Soccer West Chester, PA

LIGHTING SUMMARY	
Name:	400 Soccer Field
Spacing:	30.0'
Height:	3.0' above grade
ILLUMINATION SUMMARY	
Design Average:	5.0000
Maximum:	6.00
Minimum:	0.00
No. of Fixtures:	141
Output (Wattage):	15000.00 W
Footcandle Output:	111.0000 fc/ft²
Total Area:	88.81 kW
Footcandle Output:	15000.00 W
Footcandle Output:	15000.00 W
Footcandle Output:	15000.00 W

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.
 Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.
 Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.
 Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.



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 ILLUMINATION SUMMARY



Westtown School Soccer
West Chester, PA

EQUIPMENT LAYOUT
INCLUDES:
 - Soccer 1
 - Soccer 2
 Electrical System Requirements: Refer to Amperage Draw Chart and/or the "Musco Control System Summary" for electrical sizing.
 Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

EQUIPMENT LIST FOR AREAS SHOWN

QTY	DESCRIPTION	SIZE	WATTAGE	VOLTAGE	TYPE	WATTAGE	QTY
4	S1-S2	80'	110-140	230V	110-140	230V	16
2	S3-S4	80'	110-140	230V	110-140	230V	8

PERMITTED DIMENSIONS FOR BALLAST AND DRIVER

Ballast Specifications	Line Amperage Per Candidate
Single Phase Voltage	208V 240V 277V 300V 347V 480V
MILKED SIZE	8.8 6.9 5.0 4.5 4.2 3.7 3.8

SCALE IN FEET 1 : 60
 0 60 120
 ENGINEERED DESIGN By: Vashon Alexander • File #187863C • 11-Feb-19

Pole location(s) Ⓢ dimensions are relative to 0.0 reference point(s) Ⓢ



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EQUIPMENT LAYOUT



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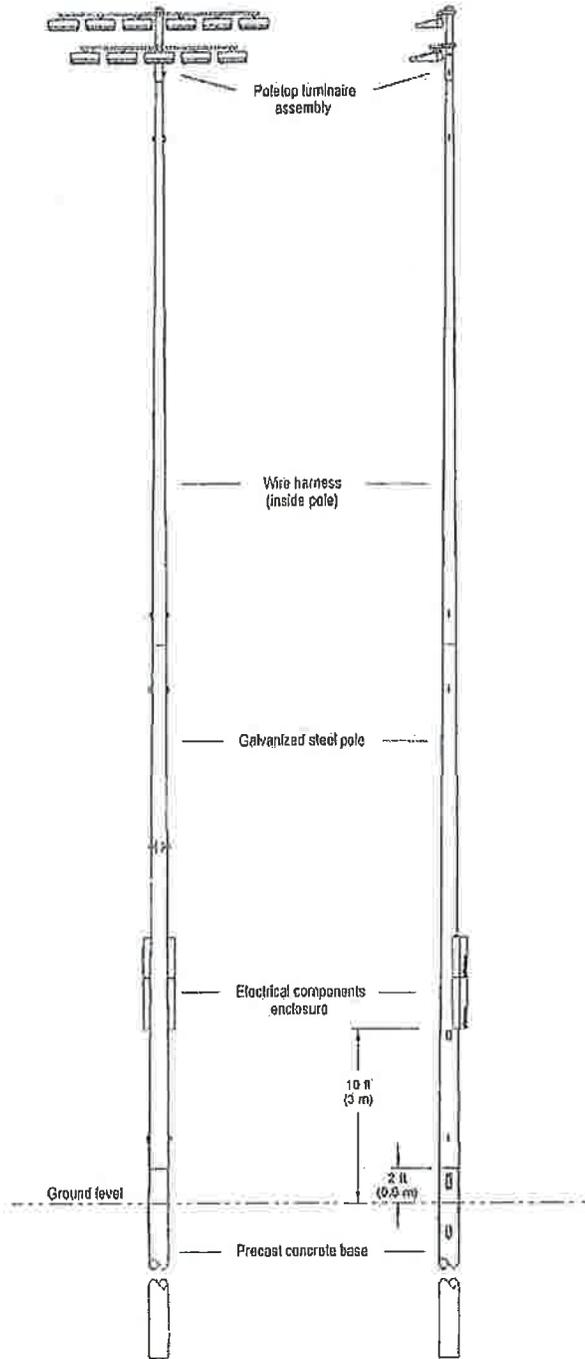


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PRELIMINARY

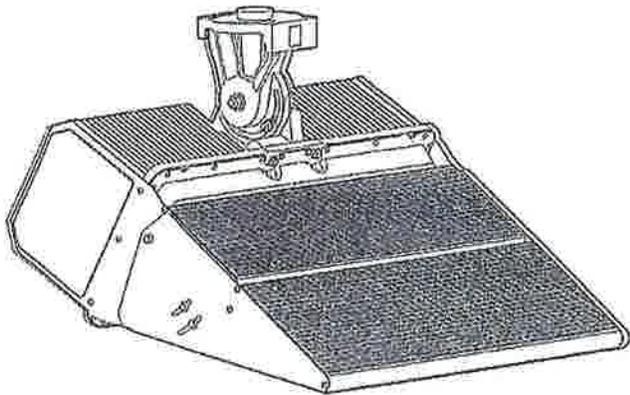
Project No.	11
Client	BUS
Contract No.	TDA
Date	10/16/18
Drawn by	M415100494.11

Light-Structure System™ typical configuration
 TLC for LED® Luminaire's

MUSCO
Lighting

CORPORATE OFFICE
 P.O. Box 608
 102 1st Avenue West
 Oak Hills, Iowa 52577
 • 1-800-825-4050
 • 1-641-872-0411

Datasheet: TLC-LED-1150 Luminaire and Driver



Luminaire Data

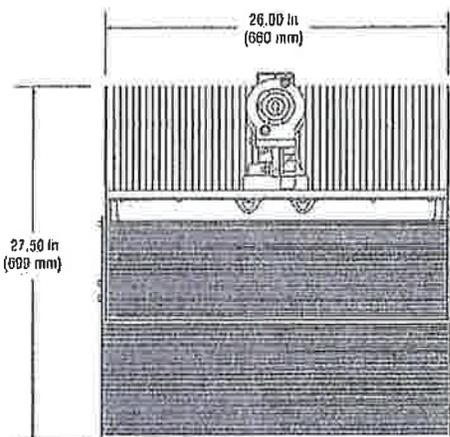
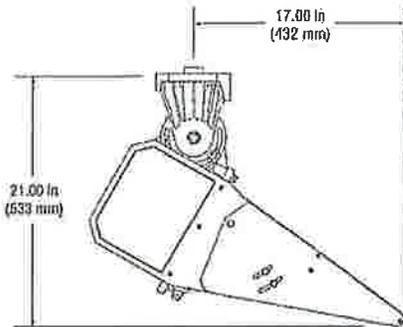
Weight (luminaire) 80 lb (36 kg)
 UL listing number E338094
 UL listed for USA / Canada UL1598 CSA-C22.2 No.250.0
 Ingress protection, luminaire, international IP65
 Ingress protection, luminaire, USA IP54
 Material and finish Aluminum, powder-coat painted
 Wind speed rating (aiming only) 150 mi/h (67 m/s)
 UL ambient temperature rating, luminaire 50°C (122°F)

Photometric Characteristics

Projected lumen maintenance per IES TM-21-11
 L90 (10.5k) >63,500 h
 L80 (10.5k) >63,500 h
 L70 (10.5k) >63,500 h
 CIE correlated color temperature 5700 K
 Color Rendering Index (CRI), typical 75
 Color Rendering Index (CRI), minimum 70
 Lumens¹ 121,000

Footnotes:

1) Lumen values at stabilized operation in 25°C ambient temperature environment. Incorporates appropriate dirt depreciation factor for life of luminaire.



Datasheet: TLC-LED-1150 Luminaire and Driver

Driver Data

Electrical Data

Rated wattage¹

Per driver..... 1,150 W

Per luminaire..... 1,150 W

Number of luminaires per driver..... 1

Starting (inrush) current..... <40 A, 256 μ s

Fuse rating..... 15 A

UL, IEC ambient temperature rating,
electrical components enclosure..... 50°C (122°F)

Ingress protection,
electrical components enclosure..... IP54

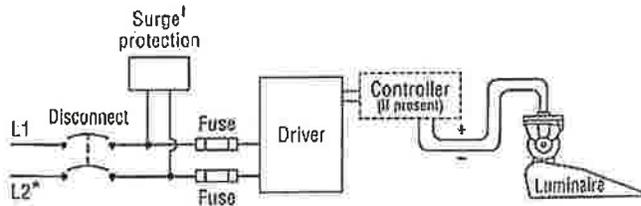
Efficiency..... 95%

Dimming mode..... optional

Range, energy consumption..... 20–100%

Range, light output..... 25–100%

Typical Wiring



* If L2 (com) is neutral then not switched or fused.
† Not present if indoor installation.

	200 Vac 50/60 Hz	208 Vac 60 Hz	220 Vac 50/60 Hz	230 Vac 50 Hz	240 Vac 50/60 Hz	277 Vac 60 Hz	347 Vac 60 Hz	380 Vac 50/60 Hz	400 Vac 50 Hz	415 Vac 50 Hz	480 Vac 60 Hz
Max operating current ² per luminaire	7.11 A	6.83 A	6.46 A	6.18 A	5.92 A	5.13 A	4.10 A	3.74 A	3.56 A	3.43 A	2.96 A

Footnotes:

- 1) Rated wattage is the power consumption, including driver efficiency losses, at stabilized operation in 25°C ambient temperature environment.
- 2) Operating current includes allowance for 0.90 minimum power factor, operating temperature, and LED light source manufacturing tolerances.

Notes

1. Use thermal magnetic HID-rated or D-curve circuit breakers.
2. See Musco Control System Summary for circuit information.





T. ALEX MEITZLER, PE, PTOE

Senior Project Manager

YEARS OF EXPERIENCE

26 Years

EDUCATION

Penn State University
M.Eng. / 1992 / Civil Engineering

Penn State University
B.S. / 1990 / Civil Engineering

REGISTRATIONS

Professional Engineer:

NJ - GE 40385

PA - #PE-052724-E

WV - #22134

DE - #11746

MD - #30181

NC - #44304

VA - #40367

DC - PE901896

Professional Traffic Operations Engineer (#1416)

PROFESSIONAL AFFILIATIONS

American Society of Highway Engineers

Institute of Transportation Engineers

Society of American Military Engineers

PERSONAL EXPERIENCE

Mr. Meitzler is a Senior Project Manager in TPD's Transportation Planning Department, with over 26 years of experience in all aspects of traffic and transportation related projects. His primary focus is relative to traffic studies, capacity analysis, signal design, and traffic operations. He is experienced with traffic analysis software packages such as SYNCHRO and HCS. He is also current with the Highway Capacity Manual 2010, MUTCD, AASHTO Green Book and Roadside Design Guide.

PROJECT EXPERIENCE

Traffic Impact Studies and Traffic Operation Analysis

New Castle & Kent Counties, DE

Project Manager responsible for the preparation of multiple TIS related to commercial and residential developments in New Castle and Kent Counties. Coordinated with DelDOT, provided data collection and analysis, developed mitigation recommendations, and prepared report for review and acceptance by DelDOT. Data collection requirements included MTM and ATR counts. Project sizes ranged from one to fifteen intersections and up to three count periods. Responsible for all analyses, schedule, coordination with the site design group, and public involvement.

Traffic Impact Study Reviews for SHA Access Management Division (SHA)

Districts 3, 5, 6 and 7, MD

Traffic Engineer providing TIS review services regarding proposed commercial and residential developments. Reviewed the studies and analyses per SHA and M-NCPPC requirements. Reviewed proposed trip generation and trip distribution patterns and made recommendations to enhance the analyses and proposed mitigation improvements. Prepared review documentation to be submitted to SHA in conjunction with concurrent H&H review.

Traffic Engineering Review Services

Pennsbury Township, Chester County PA

Provided traffic impact study (TIS) review services for Pennsbury Township as part of the approval process for a major land redevelopment submission. Worked with Township Planning Board and engineer and provided



EXHIBIT

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testimony at public hearings. The review services included full review of the developer-prepared TIS to verify adherence to Township and PennDOT standards, driveway location review, signing, striping and circulation analysis and emergency access review in conjunction with local EMS providers. Provided review letters and attended Township meetings as requested.

Traffic Engineering Services

Birmingham Township, Chester County PA

Provided a variety of traffic engineering services to Birmingham Township. These included intersection design review, and responding to requests from residents. Coordinated the annual traffic signal maintenance between the Township and PennDOT District 6-0. Responsible for ensuring the signal permit plans were properly updated and appropriate updates and changes to traffic control devices and signage were performed in the field. Coordinated these services with the Township Engineer and staff.

Traffic Operations Analysis for 2530 Concord Pike *Wilmington, DE*

Project involved the redevelopment of an existing commercial property and the creation of cross-access to an adjoining property. Managed and prepared all analysis, coordinated traffic counts, and coordinated technical details and analysis with DelDOT staff. Prepared HCS analysis, accident analysis, and safety assessment as part of the TOA report.

AI DuPont Hospital for Children Traffic Operation Analysis

New Castle County, DE

Responsible for the coordination with DelDOT of an Option B TOA and entrance plan application for a 585K SF hospital expansion. The TOA consisted of evaluating 15 signalized and unsignalized intersections. Coordinated with DelDOT and NCC, provided data collection and analysis, worked with DelDOT consultant to develop mitigation recommendations, signing and striping improvements and bicycle/pedestrian improvements. Data collection requirements included MTM and ATR counts. Worked closely with DelDOT review staff and consultants, NCC Planning, and DelDOT NCC Subdivision Review.

Traffic Impact Study for UPenn Health Systems/Children's Hospital

Philadelphia, PA

Senior Engineer for the preparation of a TIS related to the closure of the South Street Bridge and its impacts on access to the UPHS facilities and CHOP. UPHS and CHOP were preparing to redevelop the former Philadelphia Civic Center site into 6 Million SF of new hospital and research facilities. The timing of these projects needed to be closely coordinated to maintain access for emergency vehicles, patients and employees. The project addressed long term growth plans and transportation needs of the medical campus expansion. Mitigation strategies included changing circulation patterns on existing streets and adding new connections, revisions to existing coordinated signal system, and providing loading and unloading

accommodations at the medical facility entrances to reduce the number of vehicle conflicts. Other considerations included provisions for transit vehicles and taxis. Tasks included data collection, analyses, mitigation recommendations, and preparation report for review and acceptance by the UPHS, CHOP, UPenn and City of Philadelphia.

Traffic Impact Study for Pinnacle Casino *Philadelphia, PA*

Project Manager responsible for a traffic impact study related to the development of a potential casino site on the Delaware River. The project required extensive traffic analysis and coordination with PennDOT and the City of Philadelphia. The project was sensitive to surrounding residential neighborhoods. Coordinated and led data collection and analysis, developed mitigation recommendations, and prepared a report for review by the City of Philadelphia. Participated in scope revisions, budget preparation, public meetings, and client relations.

Traffic Impact Study for the Chester County Justice Center

West Chester, PA

Assessment of traffic impacts in a multi-block area of West Chester surrounding the proposed Justice Center. The project involved data collection, trip generation and distribution, assessment of transit impacts, capacity analysis, and development of alternatives. Analyzed the effects of the development on the coordinated signal system operating within the Borough of

West Chester along PA 3 (Market Street). Coordinated with PennDOT as well as other local stakeholders.

Various Assignments for DelDOT *Statewide, DE*

As part of an on-call contract, provided various traffic engineering services related to road reconstruction projects, traffic circulation improvement projects, maintenance of traffic through work zones utilizing FHWA Final Rule criteria, and analysis of signal and signage alternatives for ARRA funded projects. Assignments included signal design, traffic capacity analysis, pedestrian and ADA compliance issues, coordination with transit services, analysis and design of a new roundabout in lieu of a traffic signal, and the study of eliminating cut through traffic from a historical residential area. Involved with client coordination, project management, and public workshop meetings and presentations. These projects included: SR 301 Section 3; Howell School Road Reconstruction, Foulk Road/Murphy Road Intersection, New Castle Circulation Study, and Market Street Reconstruction in the City of Wilmington.



TRAFFIC PLANNING AND DESIGN, INC.

WWW.TRAFFICPD.COM

July 25, 2018

Mr. Timothy B. Barnard
Barnard, Mezzanotte, Pinnie & Seelaus, LLP
218 West Front Street
Media, PA 19063

RE: TRAFFIC/INTERNAL CIRCULATION/PARKING REVIEW – CONDITIONAL USE

Westtown School Turf Field Conversion/Lighting

Westtown Township, Chester County

TPD Job #WESC.00003

Dear Mr. Barnard:

As requested, Traffic Planning and Design, Inc. (TPD) has performed a review of the Conditional Use Exhibit Plans with respect to potential traffic impacts, internal circulation, and parking, per §170-1514.D.(5).(b) Outdoor Lighting from the Westtown Township Code:

"Before a conditional use is granted for recreational and sports lighting and nighttime events, the applicant will conduct traffic and parking studies and report the results to Westtown Township to determine if parking, vehicle access and egress, pedestrian walkways, and site lighting are adequate for handling the most well attended anticipated events. The studies shall be prepared by a qualified traffic consultant and shall enable the Township to identify traffic and/or parking problems associated with such events. The studies shall identify solutions and recommend improvements to mitigate adverse impacts of the lighted events, if any are found to exist."

It is TPD's understanding that the Proposed Project includes the installation of Artificial Turf/Lighting on two (2) existing fields located near the intersection of Westtown Road (S.R. 2007) and Oak Lane. It is also TPD's understanding that the total number of current fields will not increase as part of this project. However, uses that do occur in the future will be able to do so later into the evening hours at the two (2) newly-lighted fields. Therefore, it is TPD's opinion that this new evening use of the two (2) newly-lighted fields is in fact the "most well attended" use that will result from this project since heavier use during the day when all fields are in use, is a condition that already exists. Furthermore, it is anticipated that these events will occur mostly outside the peak hours of adjacent street traffic (4-6pm) and outside the peak hours of operation of the Westtown School itself. To be conservative, for the subsequent evaluation, TPD assumed some overlap between the peak hour of these new evening events and the peak hours of adjacent street traffic. Following is a summary of TPD's findings:



Traffic Impact

It is TPD's understanding that, during the weekday evenings, the newly-lighted fields are anticipated to be utilized by outside organizations, as well as Westtown School, primarily as practice space. These practices most likely will occur outside the weekday P.M. peak hour. However, to be extremely conservative for this assessment, TPD assumed the following times of operation:

- Practice sessions will occur between 5:30-10:00 P.M.
- Parents arrive for drop-off up to approximately 30 minutes before each session (first session drop-off approximately 5:00-5:30 P.M.)
- 50% of Parents drop-off and leave at the beginning of each session
- Assumed no carpooling
- Assumed no multi-child families
- Parents arrive for pickup approximately 15 minutes after each session (first session pick-up approximately 7:00-7:15 P.M.)
- 50% of Parents arrive and pick-up at the end of each session
- There will be overlap between pick-up and drop-off between sessions

It is anticipated that, based on the overlap between pick-up and drop-off, the time between sessions will experience the most site-related traffic to/from the newly-lighted fields. However, all of these overlap periods will be brief and will occur outside of the peak hours of adjacent street traffic (first overlap approximately 7:00-7:15 P.M.).

It is TPD's understanding that, the anticipated use of the newly- lighted fields could be for Travel Soccer Clubs, Travel Lacrosse, Field Hockey, etc. Based on conversations with the Project Team, TPD assumed the following for each potential use:

- Travel Soccer
 - Half-field practices are assumed. Therefore, four (4) teams per session assumed
 - 15 players and 2 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:
 - Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 68 / Exit = 30
 - End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 30 / Exit = 68
 - Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 68 / Exit = 30
 - **Overlap between Sessions = Enter = 83 / Exit = 64 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**
- Travel Lacrosse
 - Full-field practices are assumed. Therefore, two (2) teams per session assumed
 - 18 players and 2-3 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:
 - Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 42 / Exit = 18
 - End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 18 / Exit = 42
 - Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 42 / Exit = 18
 - **Overlap between Sessions = Enter = 51 / Exit = 39 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**
- Field Hockey
 - Full-field practices are assumed. Therefore, two (2) teams per session assumed
 - 15 players and 2-3 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:

- Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 36 / Exit = 15
- End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 15 / Exit = 36
- Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 36 / Exit = 15
- **Overlap between Sessions = Enter = 44 / Exit = 33 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**

As shown in the assumptions above, the scenario assuming the use of the newly-lighted fields for Travel Soccer, during the overlap between sessions, results in the most conservative in terms of trip generation (highest traffic flow), with a maximum of 83 vehicles entering or exiting.

It is TPD's opinion that based on the above extremely conservative assumptions, there will be minimal impact associated with this assumed new use since it will occur during the overlap of sessions, which occurs outside the peak hours of adjacent street traffic. Additionally, it is important to note that these "new" vehicle trips will be dispersed over the 2-3 site driveways at the existing Westtown School. Furthermore, PennDOT Average Daily Traffic (ADT) Data for the adjacent roadways are as follows:

- Westtown Road (S.R. 2007)
 - ADT = 3,200 vehicles per day (vpd)
 - Maximum Hourly Bi-Directional Volume during the Weekday P.M. = 512 vehicles (Sept 2015)
- Shady Grove Way
 - ADT = 1,369 vpd
 - Maximum Hourly Bi-Directional Volume during the Weekday P.M. = 173 vehicles (Oct 2016)

Based on the volumes shown above for Westtown Road (S.R. 2007) and Shady Grove Way, it is TPD's opinion that the anticipated trip generations listed above will not cause an impact at the existing site driveways or surrounding roadway network.

For comparison purposes, TPD performed trip generation counts at the United Sports Training Center (USTC) located in West Bradford Township during a Saturday tournament (soccer/lacrosse) in July 2014. During that tournament, eleven (11) fields were in use. TPD calculated a trip generation of 31.55 trips/field, which is less than 50% of what was assumed for purposes of this analysis. Therefore, TPD's data shows the trips/field assumed for this project are higher than those likely to be experienced. UTSC Trip Generation Data is attached for reference.

Parking Demand

Based on a review of the Conditional Use Site Plans, a parking supply of 84 parking spaces will be provided in the immediate vicinity of the two (2) newly-lighted fields. Based on the trip generations laid out above, TPD anticipates a maximum parking demand of 83 vehicles (highest directional traffic assuming Travel Soccer use with 100% retention during practice). This parking supply provides a parking surplus. Furthermore, the plan shows an additional 76 existing parking spaces available within walking distance located near the adjacent existing athletic fields, with additional parking fields located within the school campus. **Therefore, it is TPD's opinion that the parking shown on the Conditional Use Plans is more than adequate, especially since the peak nighttime parking of these fields will not overlap with the routine parking demand of the rest of the campus.**

Internal Circulation

Based on a review of the Conditional Use Site Plans, access to the newly-lighted fields will be provided from Oak Lane at three (3) locations: Western Driveway, Central Driveway and Eastern Driveway. All three (3) driveways, in addition to the internal drive aisles, will provide adequate width for two-way flow. The plan also depicts a cul-de-sac at the western portion of the plan that can be utilized for vehicle turn around. There are two (2) drop-off areas located on the plan, separate from the provided parking spaces, to allow for the pick-up/drop-off activity described previously in this letter.

We hope that these responses are helpful. If you require additional information please feel free to contact us.

Sincerely,

TRAFFIC PLANNING AND DESIGN, INC.



Matthew I. Hammond, P.E.

Executive Vice President

mhammond@trafficpd.com

Attachment: USTC Trip Generation Data

cc: George Schaab, Westtown School
Paul Lehmann, Westtown School
Mark DeINegro, Westtown School
Jason Best, ELA Group, Inc.
Charles Haley, ELA Group, Inc.
Mike Rufo, Anchor Management Group
Gary Holloway, Jr.
TPD File

WESC.00003

USTC - 2014 Counts - 11 Fields During Tournaments

Wednesday, July 9, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
7:00	0	1	0	0	0	0	0	0	1	0	1	29
7:15	6	2	0	0	0	0	0	0	8	0	8	38
7:30	3	3	4	5	0	0	0	0	6	9	15	44
7:45	3	1	0	1	0	0	0	0	4	1	5	68
8:00	2	5	2	1	0	0	0	0	7	3	10	175
8:15	9	2	1	2	0	0	0	0	11	3	14	
8:30	19	10	2	8	0	0	0	0	29	10	39	
8:45	44	19	21	28	0	0	0	0	63	49	112	
PEAK HOUR	74	36	26	39	0	0	0	0	110	65	175	

Trips/Field = **15.91**
 Enter% = **62.9%**

Tuesday, July 8, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
4:00	7	6	13	19	0	1	0	0	14	32	46	86
4:15	4	1	1	6	0	0	0	0	5	7	12	61
4:30	3	2	1	4	0	0	0	0	5	5	10	94
4:45	9	4	2	3	0	0	0	0	13	5	18	125
5:00	8	6	6	1	0	0	0	0	14	7	21	160
5:15	14	17	6	8	0	0	0	0	31	14	45	
5:30	16	10	6	9	0	0	0	0	26	15	41	
5:45	23	17	4	9	0	0	0	0	40	13	53	
PEAK HOUR	61	50	22	27	0	0	0	0	111	49	160	

Trips/Field = **14.55**
 Enter% = **69.4%**

Saturday, July 19, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
11:00	25	34	34	28	1	0	0	6	60	68	128	347
11:15	14	24	41	31	1	0	0	0	39	72	111	329
11:30	11	17	15	13	1	0	1	3	29	32	61	280
11:45	15	18	10	3	1	0	0	0	34	13	47	259
12:00	9	6	67	25	0	0	0	3	15	95	110	253
12:15	7	12	36	5	1	0	0	1	20	42	62	
12:30	8	7	18	6	0	0	0	1	15	25	40	
12:45	11	10	12	8	0	0	0	0	21	20	41	
PEAK HOUR	65	93	100	75	4	0	1	9	162	185	347	

Trips/Field = **31.55**
 Enter% = **46.7%**



TRAFFIC PLANNING AND DESIGN, INC.

WWW.TRAFFICPD.COM

November 2, 2018

Mr. William Ethridge, AICP

Westtown Township
1039 Wilmington Pike
West Chester, PA 19382

RE: Accident Data

Westtown School Oak Lane Project
Westtown Township, Chester County, PA
TPD No. WESC.00003

Dear Mr. Ethridge:

As requested and in cooperation with your traffic consultant, Al Federico, Traffic Planning & Design, Inc. (TPD) has collected accident data on Westtown Road in the vicinity of Oak Drive in support of the Conditional Use Application for the Westtown School Oak Lane Project.

TPD obtained accident information from the PennDOT data base. The query for this area over the past 5 years yielded no reportable accidents. Mr. Federico obtained a list of non-reportable accidents and an abridged version of accident reports for the past 5 years from the Westtown-East Goshen Regional Police (WEGO). Both sets of accident data are attached with this letter.

The PennDOT database did not contain any reportable accidents in the area of Oak Drive. The WEGO data shows that there were several accidents at Westtown Road / School Lane, and one accident at the curve south (towards 926) of Oak Drive. TPD confirmed with Westtown School that there were no events occurring on October 5, 2018 that may have contributed to the non-reportable crash listed.

TPD discussed the accident data with Mr. Federico. We agreed that there does not appear to be a pattern of accidents at the Oak Drive location. However, we did agree that there are opportunities to improve the visibility and safety at the Westtown Road / Oak Drive intersection which can be addressed during the land development process.



**1000 BLOCK WESTTOWN RD
NON-REPORTABLE CRASHES**

DATE	TIME	CAUSE
12/8/13	1433	SNOW
1/21/14	1444	SNOW
9/3/14	1823	FAIL NEG CURVE
2/4/15	1735	CROSS YELLOW LINE
11/14/16	1726	DEER
9/6/17	0829	FAIL NEG CURVE
9/19/18	0757	LOW HANGING WIRE
9/19/18	1644	LOW HANGING WIRE
10/5/18	1226	PARKING LOT/BACKING

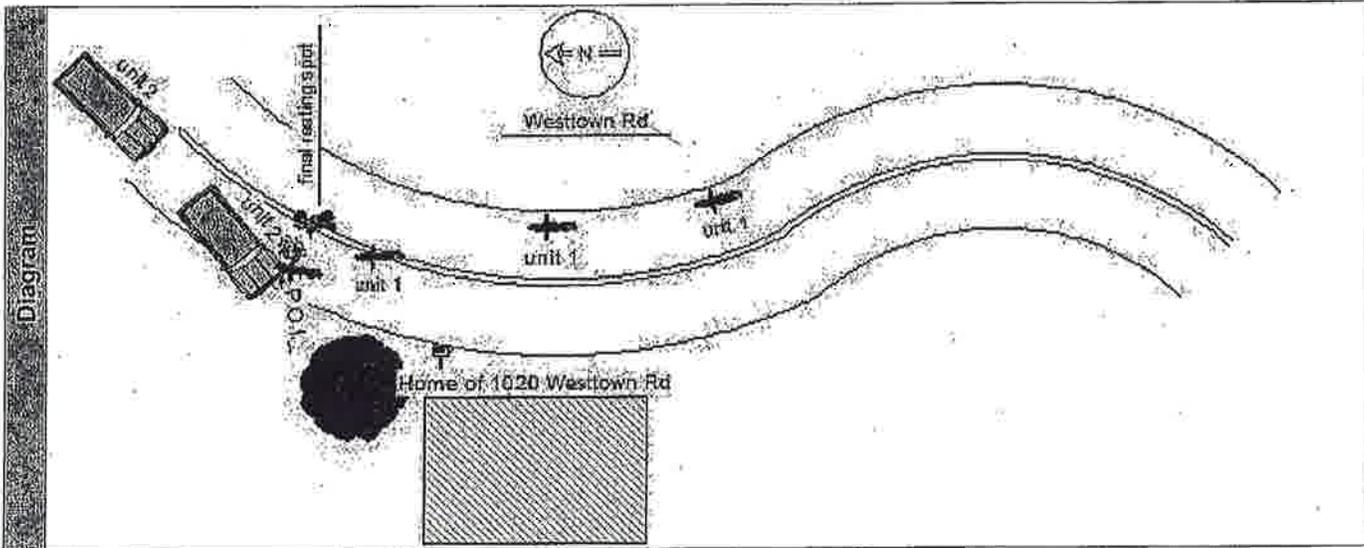
Police Agency	Agency Westtown/East Goshen Regional	Patrol Zone W	Dispatch Time 1850	Arrival Time 1855
	Investigator DIAMOND	Badge 94	Precinct	Investigation Date 06-17-2014
	Reviewer SGT. LEO J. KENNEDY	Badge 8		Approval Date 07-07-2014

Crash Data	County/Municipality Chester/Westtown Township		Crash Date 06-17-2014	Crash Time 1850	Day of Week TUESDAY	
	Crash Description Sideswipe(Opposite dir.)		Units 2	People 2	Injured 1	Killed 0
	Type of Intersection Mid-block	Special Location Not applicable	School Bus No	School Zone No	PennDOT Property Damage No	
	Illumination Daylight			Road Surface Conditions Dry		
	Relation to Roadway On roadway			Weather Conditions No adverse conditions		

Work Zone	Work Zone No	Speed Limit	Work Zone Characteristics
	Work Zone Type	Workers Present	
	Where in Work Zone	Officer Present	

Location	Principal Road				
	Route Signing County road	Route No.	Segment No.	Speed Limit 35 Mph	Travel Lanes 02
	Street WESTTOWN	Street Ending Road		Orientation North	House # 1020
	Landmark Landmark 1 0926. The distance from the crash scene to 0926 is 0.5 mile(s).				
	GPS Degrees Minutes:Seconds.Decimal Latitude : Longitude : -				
	Traffic Control Device Not applicable		Traffic Control Functioning No controls		
	Lane Closed Fully	Lane Closure Direction North and South	Traffic Detoured Yes	Estimated Time Closed < 30 minutes	
	Accident Investigation Notification Issued? No		Property Damage No		

Crash Events/Factors	First Harmful Event		Environmental/Roadway Potential Factor	
	Unit: 1	Event: Hit unit 02	None	
	Most Harmful Event			
	Unit: 1	Event: Hit unit 02		
Indicated Prime Factor Source Driver		Unit No. 01	Prime Factor Over/under compensation at curve	



Officer Jason Diamond has been a Police Officer since 2009 working as a patrol officer. In this time I have been on scene and investigated numerous motor vehicle accidents.

On 17 June 2014 at 1850 hrs I, Officer Diamond of the Westtown East Goshen Police Dept., was dispatched to the 1000 block of Westtown Rd for an accident with injuries, motorcycle vs. SUV. Upon arrival, this officer observed a white male subject lying in the center of the roadway with passerby's providing first aid. At the time of the accident, the roadways were dry with sunny conditions.

Contact was made with Richard Allen Simpson III who from this point forward will be referred to as Unit #1. Unit #1 was operating his 2005 Honda CBR 600 RR north on Westtown Rd when he approached a curve in the roadway and crashed. Unit #1 could not state what caused the accident and had trouble remembering the date and month. Unit #1 was again questioned when placed on the stretcher on what happened but could not give an answer. Unit #1 was wearing a motorcycle helmet at the time of the crash. Unit #1 had an obvious right leg fracture as well as lacerations to his left arm and side. Unit #1 was transported to Paoli Memorial Hospital by Goshen Ambulance for further treatment. His motorcycle which sustained severe damage was removed from the scene by a private tow. No written statement was obtained from Unit #1 at the time of the crash do to him stating he did not remember what happened and the severity of his injuries were going to require immediate medical attention.

Contact was then made with Elaine Vanblunk who from this point forward will be referred to as Unit #2. Unit #2 stated she was traveling south on Westtown Rd when she began to approach a curve in the roadway. Unit #2 then stated she observed a silver motorcycle traveling at a high rate of speed losing control around a curve in the roadway. Unit #2 then attempted to pull her vehicle to the shoulder of the roadway but the motorcycle crossed the double yellow line and struck her driver side front end causing moderate damage. Unit #2 was towed from the scene by Thortons Auto. No injuries were sustained to Unit #2. A written statement was obtained and attached to this original report. The written statement from Unit #2 stated the following. I was driving on Westtown Rd toward 926. A motorcycle driver came around the turn at a high rate of speed. He crossed the center line into my lane. I tried to avoid him by driving off to the right side of the road but he came right into my car and hit me.

Several attempts were made after in the days after the accident to obtain a written statement from Unit #1. On 06/22/2014, a written statement from Unit #1 was obtained which stated the following. On Tuesday, 17 June 2014, in the evening I left my place of residence on my 05 Honda CBR 600 RR with the town of West Chester as my destination. At the intersection where Street Rd (926) and Westtown Rd meet, I proceeded straight through the light onto Westtown Rd. Following the curvature of the road I made a soft left where I could see the hard right turn that I often make more then once a week. I approached the turn at approximately 25 MPH, following through the turn from the center of my lane, towards the solid white outer line, and exiting the turn returning to the center of my lane. Upon exiting the turn I was faced with a red SUV in my lane with the double yellow lines running down the center of the vehicle. This reminded me of painted racing stripes that are put on vehicles. After realizing this vehicle was on a head to head collision course with my vehicle, I applied both brakes while the driver tired to correct themselves.

Based on the evidence and the location of debris from the accident scene as well as my experience and knowledge of accidents, it was determined that Unit #1 lost control while negotiating a curve/over compensation of curve on the roadway and was struck by Unit #2 after the motorcycle had lost control and crossed the center line into the south bound travel lane of Westtown Rd. This determination was made after viewing physical evidence at the scene during the time of the crash and the location of this evidence in correlation with the curvature of this section of Westtown Rd. Furthermore, it was also determined by evidence collected by TSU Officer Frey that the motorcycle was at a low angel to the roadway at impact. (See supplement by Officer Frey). Myself and four (4) other Westtown East Goshen PD officers could not locate any visible skid marks on the roadway at the time of the accident from either Unit. MVR

Incident No: 67PJ14002772
Reportable: Y

Commonwealth of Pennsylvania
Police Crash Report

Report Number: W0417441
Case Closed: Y

Narrative

footage from the vehicles showed the final resting spot for both Units as well as the location of Unit #1 in the roadway.

Incident No: 67PJ15004430
Reportable: Y

Commonwealth of Pennsylvania
Police Crash Report

Report Number: W0499785
Case Closed: Y

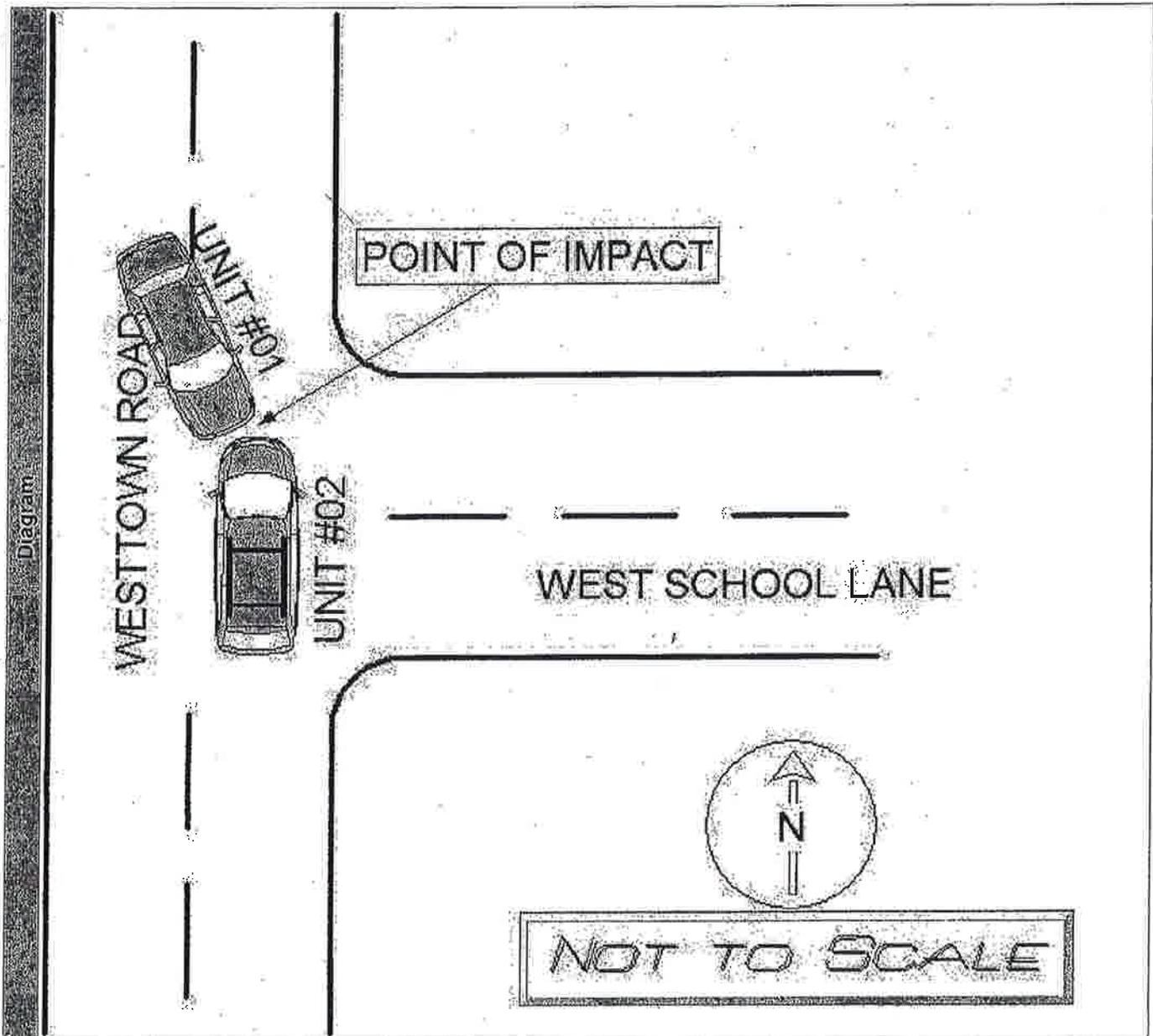
Police Agency	Agency Westtown/East Goshen Regional	Patrol Zone W	Dispatch Time 1455	Arrival Time 1459
	Investigator HERMAN	Badge 97	Precinct	Investigation Date 09-15-2015
	Reviewer SGT. LEO J. KENNEDY	Badge 8		Approval Date 09-16-2015

Crash Data	County/Municipality Chester/Westtown Township		Crash Date 09-15-2015	Crash Time 1440	Day of Week TUESDAY
	Crash Description Head-on		Units 2	People 3	Injured 1 Killed 0
	Type of Intersection T Intersection	Special Location Not applicable	School Bus No	School Zone No	PennDOT Property Damage No
	Illumination Daylight		Road Surface Conditions Dry		
	Relation to Roadway On roadway		Weather Conditions No adverse conditions		

Work Zone	Work Zone No	Speed Limit	Work Zone Characteristics
	Work Zone Type	Workers Present	
	Where in Work Zone	Officer Present	

Location	Principal Road				
	Route Signing State highway	Route No.	Segment No.	Speed Limit 35 Mph	Travel Lanes 02
	Street WESTTOWN	Street Ending Road		Orientation North	House #
	Intersecting Road WEST SCHOOL LANE				
	GPS Degrees Minutes:Seconds.Decimal Latitude : Longitude : -				
	Traffic Control Device Not applicable		Traffic Control Functioning No controls		
	Lane Closed Not applicable	Lane Closure Direction		Traffic Detoured	Estimated Time Closed
	Accident Investigation Notification Issued? No		Property Damage No		

Crash Events/Factors	First Harmful Event		Environmental/Roadway/Potential Factor	
	Unit: 1	Event: Hit unit 02	1	None
	Most Harmful Event		2	
	Unit: 2	Event: Struck by unit 01	3	
	Indicated Prime Factor Source Driver	Unit No. 01	Prime Factor Driver was distracted	



Narrative On September 15, 2015 at approximately 1445 hours Unit #01 was traveling South on Westtown Road and attempted to turn left into West School Lane when he struck Unit #02 who was traveling North on Westtown Road. Both vehicles had to be towed from the scene by Thornton's Gulf. Unit #02's front seat passenger was transported by Goshen EMS to Chester County Hospital.

Incident No: P16018674
Reportable: Y

Commonwealth of Pennsylvania
Police Crash Report

Report Number: W0565706
Case Closed: N

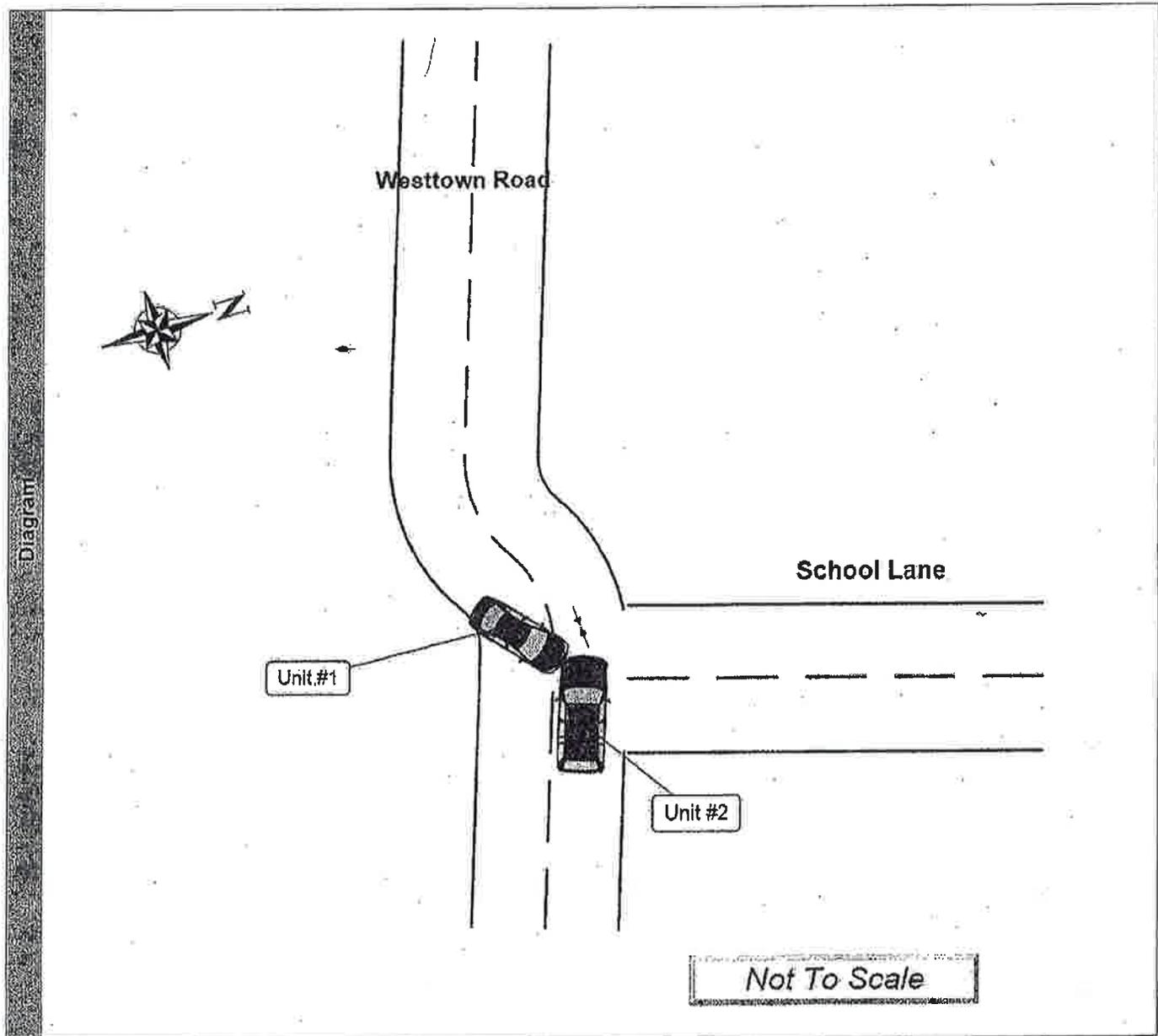
Police Agency	Agency	Patrol Zone	Dispatch Time	Arrival Time
	Westtown/East Goshen Regional	40	1552	1556
	Investigator	Badge	Precinct	Investigation Date
	FRASCELLA	86		09-09-2016
	Reviewer	Badge		Approval Date
	SGT. LEO J. KENNEDY	8		09-12-2016

Crash Data	County/Municipality		Crash Date	Crash Time	Day of Week	
	Chester/Westtown Township		09-09-2016	1549	FRIDAY	
	Crash Description		Units	People	Injured	Killed
	Head-on		2	2	0	0
	Type of Intersection	Special Location	School Bus	School Zone	PennDOT Property Damage	
	T intersection	Not applicable	No	No	No	
Illumination			Road Surface Conditions			
Daylight			Dry			
Relation to Roadway			Weather Conditions			
On roadway			No adverse conditions			

Work Zone	Work Zone	Speed Limit	Work Zone Characteristics
	No		
	Work Zone Type	Workers Present	
		Officer Present	
	Where in Work Zone		

Location	Principal Road				
	Route Signing	Route No.	Segment No.	Speed Limit	Travel Lanes
	Local road or street			45 Mph	02
	Street	Street Ending		Orientation	House #
	WESTTOWN	Road		East	
	Intersecting Road				
	SCHOOL LANE				
	GPS Degrees Minutes:Seconds.Decimal				
	Latitude : Longitude : -				
	Traffic Control Device			Traffic Control Functioning	
Not applicable			No controls		
Lane Closed	Lane Closure Direction		Traffic Detoured	Estimated Time Closed	
Partially	East and West		Yes	< 30 minutes	
Accident Investigation Notification Issued?			Property Damage		
Yes			No		

Crash Events Factors	First Harmful Event		Environmental/Roadway/Potential Factor	
	Unit:	Event:	1	None
	1	Struck by unit 02		
	Most Harmful Event		2	
	Unit:	Event:	3	
1	Struck by unit 02			
Indicated Prime Factor Source		Unit No.	Prime Factor	
Driver		01	Driver inexperienced	



Description of scene/Location:

The location of the incident was Westtown Road and School Lane in Westtown Township, Chester County. The area is the entrance to Westtown School. Westtown Road runs in a east/west direction and School Lane runs north. The area of this incident is a two lane local road with a speed limit of 45 MPH.

Synopsis:

On 9/9/2016 at 15:52 hrs I was dispatched to a two vehicle crash in the area of Westtown Road and School Lane. Upon arrival I found a red Ford Tarsus (Unit #1) bearing PA Registration 16767PD with heavy front end damage blocking the road way. The second involved vehicle, blue Chevy Tahoe bearing PA Registration GGX-6993 (Unit # 2) was stopped on the shoulder of the roadway.

I made contact with the operator of Unit #2, Francis Ely, who advised he was traveling west on Westtown road when the red Ford Tarsus (Unit #1) turned directly in his path.

I made contact with the operator of Unit #1, William Haviland Jr, who advised he was attempting to turn left from Westtown Road on to School Lane when his vehicle was struck by Unit # 2.

Unit #1 and Unit #2 struck head on. Both units sustained heavy damage and were towed from the location.

Incident No: P18292796
Reportable: Y

Commonwealth of Pennsylvania
Police Crash Report

Report Number: W0700532
Case Closed: Y

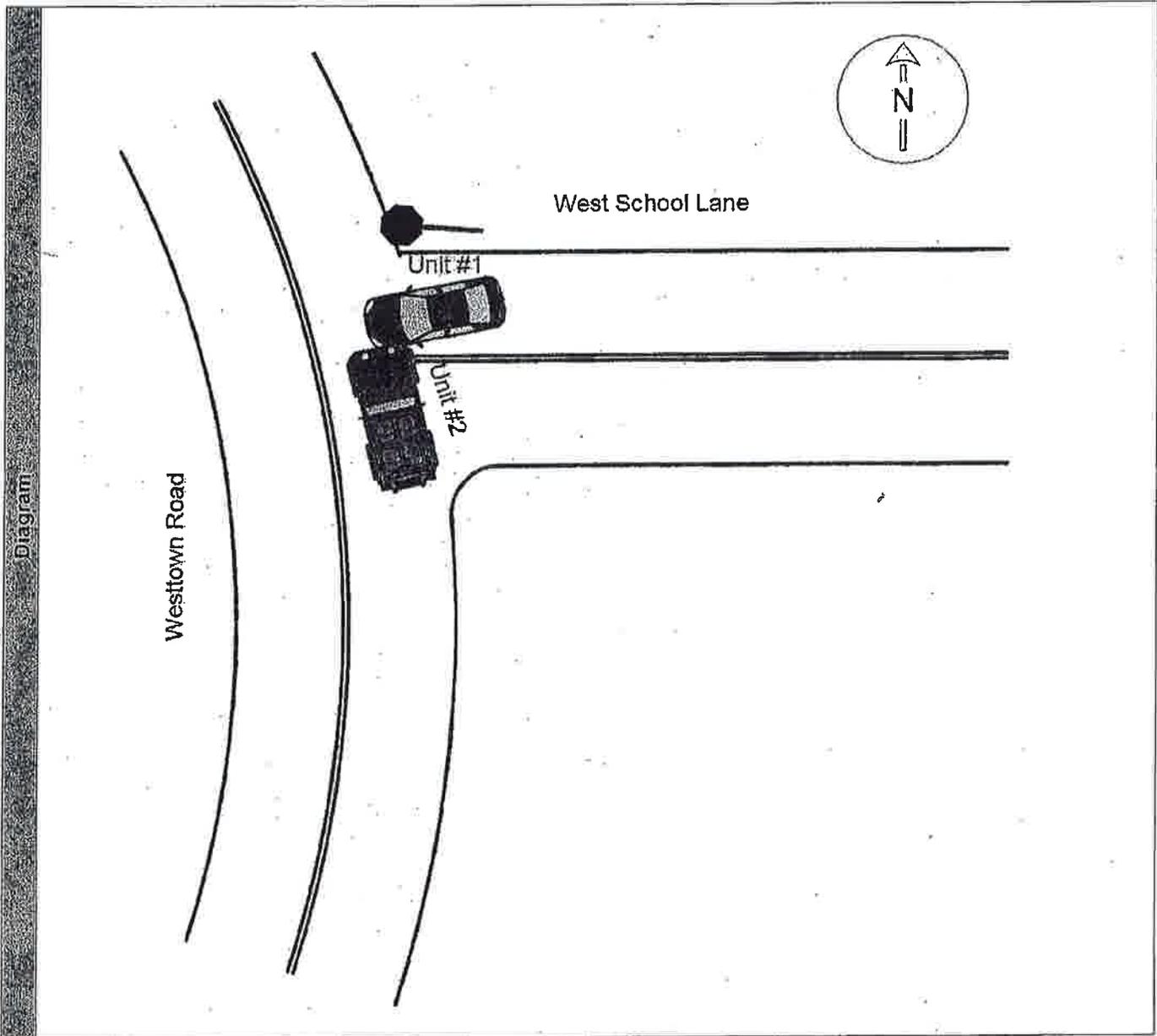
Police Agency	Agency	Patrol Zone	Dispatch Time	Arrival Time
	Westtown/East Goshen Regional	W	1555	1600
	Investigator	Badge	Precinct	Investigation Date
	OFFICER ARMBRUSTER	43	WESTTOWN	10-16-2018
	Reviewer	Badge		Approval Date
	TED LEWIS	47		10-17-2018

Crash Data	County/Municipality		Crash Date	Crash Time	Day of Week	
	Chester/Westtown Township		10-16-2018	1555	TUESDAY	
	Crash Description		Units	People	Injured	Killed
	Angle		2	2	0	0
	Type of Intersection	Special Location	School Bus	School Zone	PennDOT Property Damage	
T intersection	Not applicable	No	No	No		
Illumination			Road Surface Conditions			
Daylight			Dry			
Relation to Roadway			Weather Conditions			
On roadway			No adverse conditions			

Work Zone	Work Zone	Speed Limit	Work Zone Characteristics
	No		
	Work Zone Type	Workers Present	
	Where in Work Zone	Officer Present	

Location	Principal Road				
	Route Signing	Route No.	Segment No.	Speed Limit	Travel Lanes
	County road			35 Mph	02
	Street	Street Ending		Orientation	House #
	WESTTOWN	Road		North	
	Intersecting Road				
	WEST SCHOOL LANE				
	GPS Degrees Minutes:Seconds.Decimal				
	Latitude : Longitude : -				
	Traffic Control Device			Traffic Control Functioning	
Stop sign			Device functioning properly		
Lane Closed	Lane Closure Direction		Traffic Detoured	Estimated Time Closed	
Partially	South		No	< 30 minutes	
Accident Investigation Notification Issued?			Property Damage		
Yes			No		

Crash Events/Factors	First Harmful Event		Environmental/Roadway Potential Factor	
	Unit:	Event:		1 None
	1	Struck by unit 02		
	Most Harmful Event			
Unit:	Event:	2		
1	Struck by unit 02			
Indicated Prime Factor Source		Unit No.	Prime Factor	
Driver		01	Proceeding w/o clearance after stop	



Diagram

Narrative

On October 16, 2018 at 1555 hours this officer was dispatched to the intersection of Westtown Road and West School Lane for an accident.

Upon arrival this officer spoke to the driver of Unit #1 who stated he was attempting to make a left turn from West School Lane into the southbound lane of Westtown Road. The driver stated he did not see Unit #2 who was travelling North on Westtown Road. Both units collided in the northbound lane of Westtown Road causing damage to the front of Unit #2 and the driver's side, front and passenger's side of Unit #1. The driver of unit #1 stated he caused the accident.

Unit #1 was towed to Thornton's Gulf by Thornton's Towing. Both drivers stated they were not injured as a result of the accident. Both driver's were issued exchange forms.

NO CRASH RECORDS AVAILABLE

PCIT Query number 0320181023698 has returned zero crash records and no crash information can be displayed. A Crash Resume Report can not be generated as requested. Please check query location parameters, indicators and date ranges for the query as necessary.

Pennsylvania Crash Information Tool

Westtown Road (SR 2007) and Oak Lane

Sorted by County, Route, Segment, Offset

NOTES:

1 **Injury Severity Disclaimer**

Please note that beginning January 1, 2016, PennDOT adopted the Federal standard for collecting injury severity data. The field descriptions and definitions changed from the state standard that had been in use for decades. This resulted in a substantial shift in severity levels. Therefore, comparison of the "Suspected Serious Injury", "Suspected Minor Injury" and "Possible Injury" categories will not be consistent for crashes taking place before versus after the adoption of the new standard.

2 **Complete data years**

Complete records of reportable crashes are available in PCIT for the following years: 1998 - 2017

REPORT PARAMETERS:

Query ID: 0320181023698

User ID: b-bhaesler

Area of Interest: (In County 15 On State Route 2007(P) Between Segment 0030 Offset 0972 and Segment 0030 Offset 1972)

Date Range: 01/01/2013 to 12/31/2017

Criteria:



TRAFFIC PLANNING AND DESIGN, INC.

WWW.TRAFFICPD.COM

November 2, 2018

Mr. William Ethridge, AICP

Westtown Township
1039 Wilmington Pike
West Chester, PA 19382

RE: Athletic Practice Trip Generation Counts

Westtown School Oak Lane Project
Westtown Township, Chester County, PA
TPD No. WESC.00003

Dear Mr. Ethridge:

As requested by your traffic consultant, Al Federico, Traffic Planning & Design, Inc. (TPD) has performed field observations of multi-team athletic practices to determine traffic trip generation rates and patterns in support of the Conditional Use Application for the Westtown School Oak Lane Project. Below is a summary of our observations and findings.

We observed lacrosse practices at the Westtown School Oak Lane fields on Sunday, October 28, 2018 between 12 noon and 2pm, and soccer practices at the West Chester United Soccer Club on Westtown Road in West Chester, PA on Thursday, November 1, 2018 between 4:30pm and 8pm. Observations from both periods will be presented below and summarized at the end of this letter.

Westtown School Oak Lane Fields Observations

Girls Lacrosse practices were observed on Sunday, October 28, 2018 between 12 noon and 2pm. There were 5 teams utilizing the fields between 12noon and 2pm. TPD observed 78 players and 7 coaches, which nearly matches the 15 players and 2 coaches per team assumed for 'worst case scenario'. The one 'anomaly' observed was that one team arrived via a school bus (1 coach and 12 players). For the purposes of summarizing the data for these observations, TPD is assuming those players and coach arrived via private vehicle at the same rate as the other teams, which is approximately 1.5 players/vehicle. It should be noted to Westtown Township that teams are utilizing buses to get to their practices, and that significantly cuts down on the number of potential trips generated.



Average occupancy/vehicle entering – $72/50 = 1.44^*$
 Average occupancy/vehicle exiting – $72/46 = 1.56^*$
 Average rate – $1.56+1.44/2 = 1.5$ occupants/vehicle*
 % players/coaches dropped off – 35 drop off/50 total trips = 70% (higher than assumed originally)
 % players/coaches stay – 15 stay/50 total trips = 30% (lower than assumed originally)
 *-does not include 12 players and coach who arrived by bus

Using the above vehicle occupancy rates, drop off/stay percentages, and TPDs original assumption of utilizing half field soccer practices, at four teams of 15 players with 2 coaches each (68 total participants) and assuming all participants arrived in a privately operated vehicle:

45 entering trips at the beginning of practice (68/1.5 people per vehicle).
 32 exiting trips from drop off.
 13 vehicles stay for entire practice.

At turnover time in between practices (peak condition) using same methodology as TPD July 25, 2018 letter:

61 peak entering trips (32/2 from first practice pickup plus 45 for second practice)
 55 exiting trips (45/2 from first practice plus 32 drop off for second practice).

Peak Rate Comparison:

<u>Observed Rate</u>	<u>Assumed Rate</u>
61 entering	83 entering
55 exiting	64 exiting

West Chester Sports Association Sports Complex Soccer Field Observations

Girls Soccer practices were observed on Thursday, November 1, 2018 between 4:30pm and 8pm. There were 3 teams utilizing the soccer field at a time during two evening practice sessions (6 teams total). TPD observed a total of 92 players and 6 coaches, which nearly matches the 15 players and 2 coaches per team assumed for 'worst case scenario'. Because of the other sports occurring at the facility (football and softball), we were not able to accurately assess after practice pick up trips during the practice turnover period. For the purposes of this data set, we will be assuming the average occupancy of soccer related entering and exiting vehicles is the same.

Average occupancy/vehicle – $98/84 = 1.17$
 % players/coaches dropped off – 35 drop off/84 total trips = 42% (lower than assumed originally)
 % players/coaches stay – 49 stay/84 total trips = 58% (higher than assumed originally)

Using the occupancy and drop off/stay percentages, and TPDs original assumption of utilizing half field soccer practices, at four teams of 15 players with 2 coaches each (68 total participants) and assuming all participants arrived in a privately operated vehicle:

59 entering trips at the beginning of practice (68/1.17 people per vehicle).
 25 exiting trips from drop off.
 34 vehicles stay for entire practice.

At turnover time in between practices (peak condition) using same methodology as July 25, 2018 letter:

72 entering trips at turnover (25/2 from first practice pickup plus 59 for second practice)

55 exiting trips (59/2 from first practice plus 25 drop off for second practice).

Peak Rate Comparison:

Observed Rate Assumed Rate

72 entering 83 entering

55 exiting 64 exiting

The results of the observations show that at both facilities during both observed time periods and practices, the observed peak trip generation rate was less than that assumed in our July 25, 2018 letter. The observations confirm that the original trip generation estimates were conservative, but reasonably close to actual trip generation rates from similar existing facilities. The weekday evening observations from November 1, 2018 most closely relate the projected trip generation characteristics of the proposed use at the Westtown School Oak Lane athletic fields.

Please contact me if you have any questions regarding the above information pertaining to this project.

Sincerely,

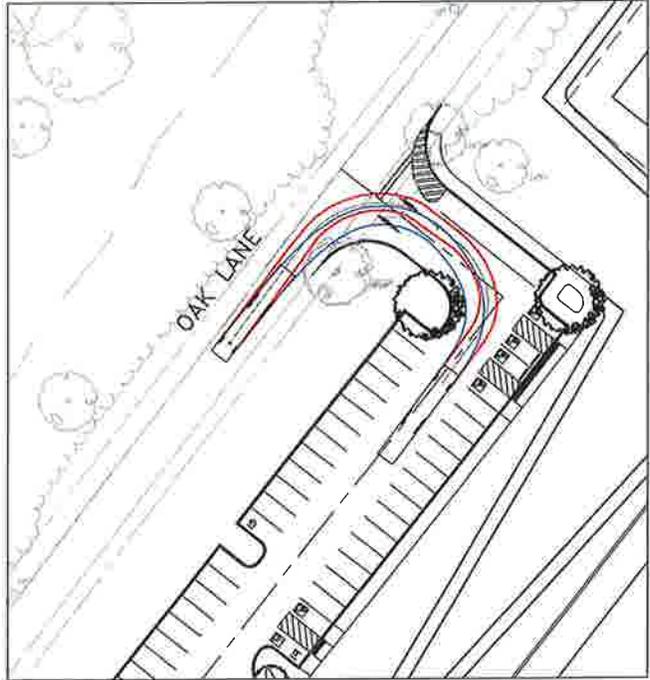
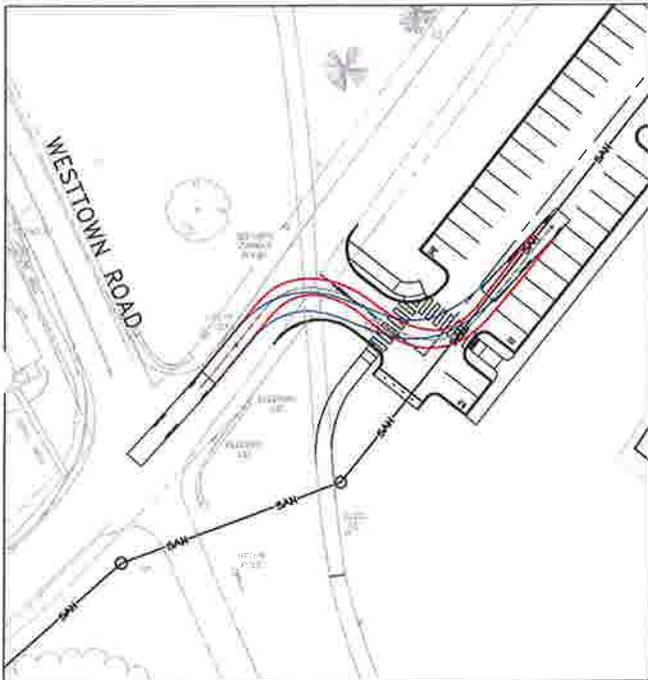
TRAFFIC PLANNING AND DESIGN, INC.



Alex Meitzler, PE, PTOE
Senior Project Manager

ameitzler@TrafficPD.com

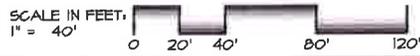
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EMERGENCY VEHICLE TURNING MOVEMENTS
 WESTTOWN SCHOOL



SCALE: 1" = 40'
 DRAWN BY: SHL
 DATE: NOVEMBER 2018

JOB NUMBER:
 1091-001

DRAWING: N/A
 SKETCH: 1 OF 1

EXHIBIT

tabbles

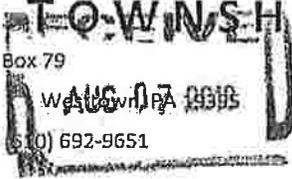
A-20



WESTTOWN TOWNSHIP

1039 Wilmington Pike
West Chester, PA 19382
PHONE: (610) 692-1930

P.O. Box 79
Westtown, PA 19382
FAX: (610) 692-9651



CONDITIONAL USE APPLICATION

Date received: _____ Date of acceptance: _____ Date of rejection: _____

Location of proposed use

Address: 975 Westtown Road City: West Chester State: PA Zip: 19382

Owner: Westtown School

Tax parcel number(s): 67-5-27 Zoning district: Agricultural/Cluster Residential Acreage: 195 acres Applicant's total property <600 acres

Proposed use of property: Athletic fields, parking and supporting accessory structures

Applicant information

Applicant: Timothy B. Barnard, Esquire for Westtown School

Address: 218 W. Front St., P.O. Box 289 City: Media State: PA Zip: 19063

Phone number: 610-565-4055 E-mail address: tbarnard@bmplaw.net

I (We) hereby make application for CONDITIONAL USE of the above-described property as provided for in Section 170-1514.0(5) of the Westtown Township Zoning Ordinance, and do hereby acknowledge that I (we) have read this application and confirm that the above information is correct, and do further confirm that I (we) agree to comply with all provisions of the Westtown Township Zoning Ordinance applicable to this project.

Timothy B. Barnard
Signature of applicant

8/7/2018
Date

Signature of Zoning Officer

Date

A-21

**WESTTOWN TOWNSHIP BOARD OF SUPERVISORS
APPLICATION FOR CONDITIONAL USE UNDER
THE TOWNSHIP LIGHTING ORDINANCE
SECTION 170-1514.D.(5)**

Applicant: Westtown School
UPI No. 67-5-27
975 Westtown Road
West Chester, PA 19382

Date of Submission: August 7, 2018

NARRATIVE

Westtown School is the owner of several large contiguous properties totaling slightly in excess of 600 acres. A portion of the center of the Westtown School campus is used for athletic fields adjacent to a driveway access along the roadbed of what was formerly Oak Lane. It is proposed that two of those fields be improved as turf fields to accommodate the current needs of athletic competition both by the student body and the local community athletic organizations. Because of the prospective use of those two fields during evening hours, a conditional use is requested to allow for the fields to be lighted. It is intended that the lighted fields be available for the days of Monday through Saturday throughout the period of August 15 to June 15 each year. The lighting would be extinguished no later than 10:00 p.m. each day and would be accomplished through the use of new generation LED shielded fixtures that eliminate glare to the surrounding neighborhood. The use of these fields by the community is a necessary component to the financial viability of the turf fields and lighting and provides a much needed service to community athletic groups.

The proposed fields, lighting and use require adjustments to several elements of the current Township lighting ordinance. To address the required variation from the terms of that ordinance, some simple amendments have been proposed to the lighting ordinance to permit a property in excess of 400 contiguous acres to construct lighted fields for use (i) by outside parties, (ii) on a reasonably regular basis throughout nine months of the year and (iii) to include at least two such fields. Such accommodations are to be allowed only through the grant of conditional use approval by the Township Board of Supervisors. Circumstances supporting this relief include the location of the fields (*the closest houses to the nearest light pole being at least 1500 feet*), the size of the property (*approximately 600 acres*), the limitations upon the use of the fields (*largely practice events for soccer, field hockey and lacrosse and no football games*), a carefully laid out traffic and parking plan and the use of a high tech lighting system that is designed to eliminate the prospect of glare generated by the field lighting that might otherwise impact neighboring properties.

That ordinance amendment and Westtown School's Conditional Use Application seeking relief under the proposed amended ordinance are now before the Township for consideration and approval. Accompanying this Application for Conditional Use are (i) a summary of the LED lighting system, (ii) a map reflecting the proximity of independent housing adjacent to the fields, (iii) two illustrative exhibits reflecting the nature of the

new era lighting system, (iv) a general plan of the School property and a detail of the area in which the fields are located, (v) a stormwater management narrative by ELA Group and (vi) a traffic and parking study by Traffic Planning and Design.



WE BUILD WINNERS.

August 7, 2018

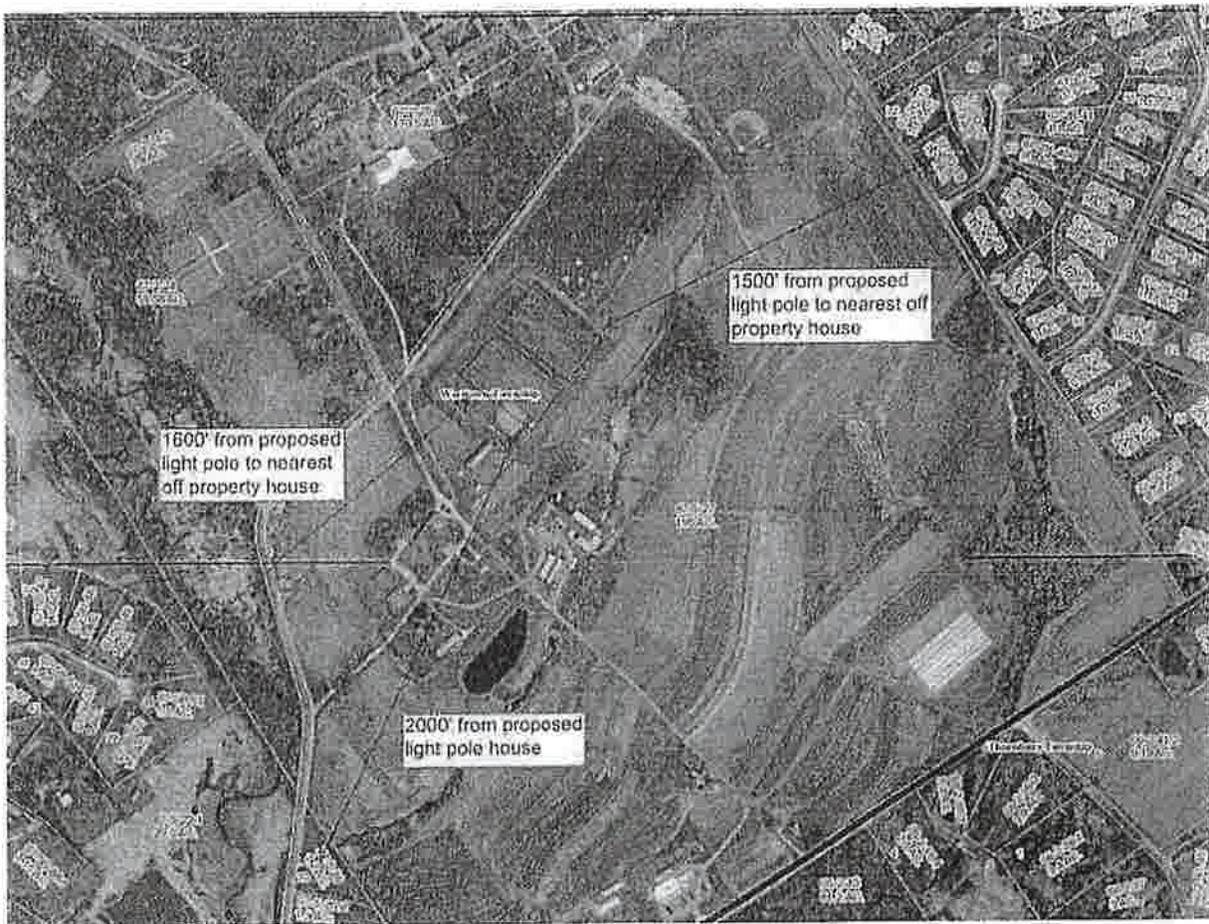
*Westtown School
LED Lighting System Summary*

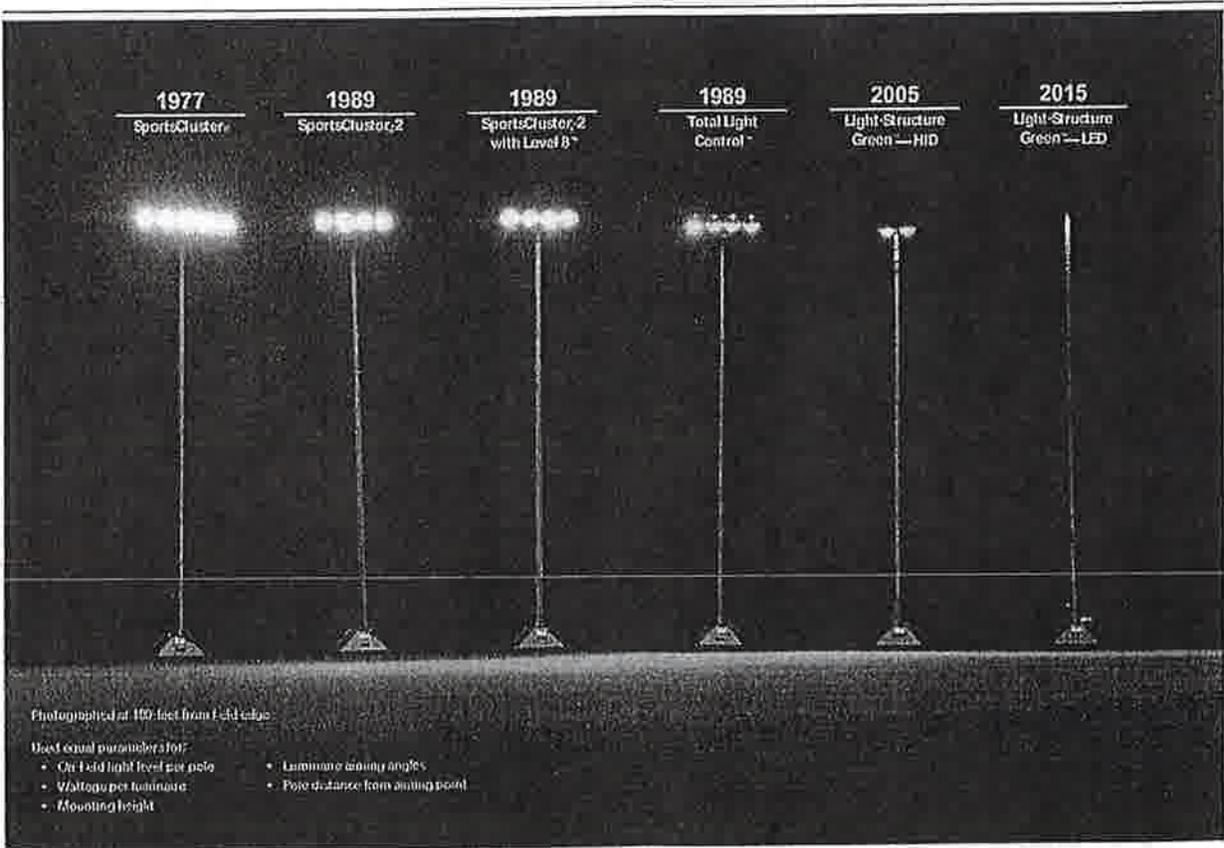
In the last 10 years LED Systems have revolutionized the sports lighting industry with major advances in technology. Unlike previous HID lighting, the new lights provide a system that eliminates glare to the surrounding neighborhoods and provides uniform light levels with controlled light overspill. A well-designed lighting system controls maximum useful on-field illumination with minimal destructive off-site glare. The elimination of glare is a direct result of the design of "full cut off" light fixtures installed at the proper height. The height of the light poles allows the light to be precisely directed down on the field of play resulting in less light pollution and elimination of spillage into the sky.

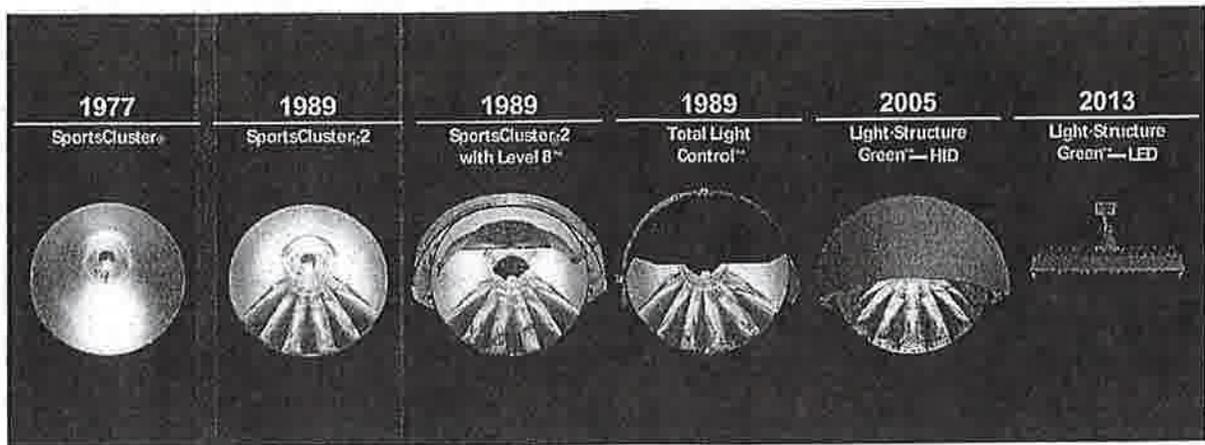
LED Systems are digital lighting systems offering instant on-off capabilities, intelligent controls and adjustability. In addition, and more important for communities, compared to the previous HID lighting system, the new lights can control light distribution by factory calibrated optics which reduces glare for immediate neighborhood, spectators, and participants. The lighting design takes into account that LEDs are more efficient than metal halides allowing the Institution to install fewer light fixtures (A 600W LED light will produce more light than a 1000W metal halide). Additionally, the LED uses a precise lens to direct the light exactly where it is needed. When mounted in the proper location, an LED lighting solution provides a high-tech system that uses a laser aiming device to ensure the lights are correctly positioned, meeting the needs of the Institution, while limiting the visual effect on the neighbors.

A unique lighting design for two playing fields has been designed for Westtown School. The Musco lighting system consists of six (6) 80' poles, with eleven (11) "full cut off" luminaires on the perimeter poles and twenty-two "full cut off" luminaires on the interior poles serving fields in both directions. The use of "full cut off" fixtures eliminates light pollution, light spill and glare. The intelligent control system will allow adjustment of illumination based on use, ranging from minimal foot-candles to a maximum average of 50.3 foot-candles distributed evenly.

When the system is complete, there is a means to measure the lighting and quantify glare. Illuminance quantifies the light incident within an area and is measured in foot-candles. Luminance quantifies the light emitted from an area and is measured in candela per square meters. The lighting designer has provided us with a "Spill Summary" which will be measured and verified with a light meter after installation. By combining this new technology with proper light placement, we are able to control the light distribution on the fields and minimize light spill immediately adjacent to the playing surface. The system addresses the needs of the community with minimal impact to the surrounding neighborhoods.





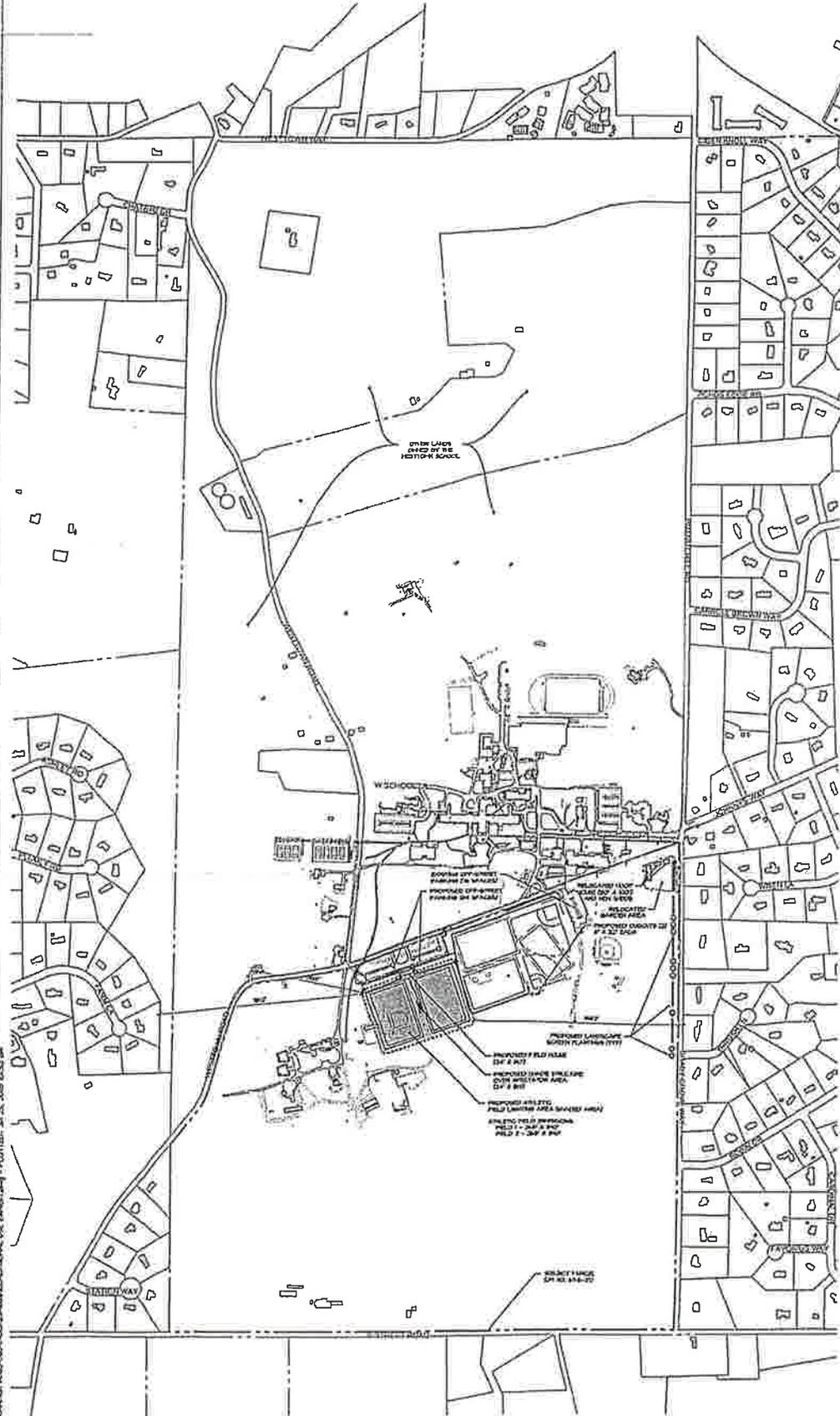


SITE PLAN

CONDITIONAL USE APPLICATION

WESTTOWN SCHOOL - OAK LANE PROJECTS

WESTTOWN TOWNSHIP - CHESTER COUNTY - PENNSYLVANIA



OWNER/APPLICANT

WESTTOWN SCHOOL
100 WEST CHESTER PA 19380
(610) 399-0000

SOURCE OF TITLE

AS SHOWN
DEED BOOK 1 VOL. PAGE 54



SCALE IN FEET: 1" = 50'

0 50 100 150





WESTTOWN SCHOOL – OAK LANE PROJECTS
STORMWATER MANAGEMENT NARRATIVE
FOR CONDITIONAL USE APPLICATION

The Westtown School's Oak Lane Project includes two watershed areas, which both contribute to an unnamed tributary to the East Branch of the Chester Creek (TSF-MF stream classification). Pending a geotechnical investigation to ascertain the site's ability to safely infiltrate storm runoff, it is anticipated that rate control, volume control, and water quality BMPs will be employed in the final stormwater management design.

The stormwater management plan for the project will comply with the applicable ordinances and NPDES Permit requirements and is expected to include the following features/BMPs:

- Pervious Pavement with Infiltration Bed (beneath proposed parking stalls)
- Subsurface Infiltration Beds (beneath the proposed synthetic turf fields)
- Infiltration Trenches beneath lawn areas to supplement conventional detention and infiltration basins.
- Rain Gardens, to accomplish both infiltration and water quality objectives
- Conventional (surface) Detention and Infiltration Basin(s) to de-peak the rate of discharge for the runoff and to reduce volume.
- Protect/Conserve/Enhance Riparian Areas, within the perennial stream corridor and in delineated wetland areas to protect and maintain the integrity of the channel and reduce impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals

The stormwater management plan being contemplated includes the following concepts, which will be fully vetted as the geotechnical engineering testing and design process ensue:

Runoff from the fields and half of the proposed field house will flow southeast and will be intercepted and detained prior to being discharged into the perennial stream channel/wetland area located down-gradient. Pending verification of the efficacy of stormwater infiltration onsite by the project Geotechnical Consultant, the requisite portion of the increased runoff volume will be infiltrated through one of the subsurface BMPs listed above. The wetland areas located on the Westtown School's property and situated immediately downstream from the proposed development will be protected, conserved, and possibly enhanced through the removal of invasive species.

Runoff from the proposed field house and associated parking area will flow west/southwest and will be intercepted and detained prior to being discharged into the natural drainageway immediately across Oak Lane. Pending verification of the efficacy of stormwater infiltration onsite by the project Geotechnical Consultant, the requisite portion of the increased runoff volume will be infiltrated through the infiltration beds below the pervious pavement and/or through the rain garden(s) being proposed nearby.



TRAFFIC PLANNING AND DESIGN, INC.

WWW.TRAFFICPD.COM

July 25, 2018

Mr. Timothy B. Barnard
Barnard, Mezzanotte, Pinnie & Sealaus, LLP
218 West Front Street
Media, PA 19063

RE: TRAFFIC/INTERNAL CIRCULATION/PARKING REVIEW – CONDITIONAL USE

Westtown School Turf Field Conversion/Lighting

Westtown Township, Chester County

TPD Job #WESC.00003

Dear Mr. Barnard:

As requested, Traffic Planning and Design, Inc. (TPD) has performed a review of the Conditional Use Exhibit Plans with respect to potential traffic impacts, internal circulation, and parking, per §170-1514.D.(5).(b) Outdoor Lighting from the Westtown Township Code:

"Before a conditional use is granted for recreational and sports lighting and nighttime events, the applicant will conduct traffic and parking studies and report the results to Westtown Township to determine if parking, vehicle access and egress, pedestrian walkways, and site lighting are adequate for handling the most well attended anticipated events. The studies shall be prepared by a qualified traffic consultant and shall enable the Township to identify traffic and/or parking problems associated with such events. The studies shall identify solutions and recommend improvements to mitigate adverse impacts of the lighted events, if any are found to exist."

It is TPD's understanding that the Proposed Project includes the installation of Artificial Turf/Lighting on two (2) existing fields located near the intersection of Westtown Road (S.R. 2007) and Oak Lane. It is also TPD's understanding that the total number of current fields will not increase as part of this project. However, uses that do occur in the future will be able to do so later into the evening hours at the two (2) newly-lighted fields. Therefore, it is TPD's opinion that this new evening use of the two (2) newly-lighted fields is in fact the "most well attended" use that will result from this project since heavier use during the day when all fields are in use, is a condition that already exists. Furthermore, it is anticipated that these events will occur mostly outside the peak hours of adjacent street traffic (4-6pm) and outside the peak hours of operation of the Westtown School itself. To be conservative, for the subsequent evaluation, TPD assumed some overlap between the peak hour of these new evening events and the peak hours of adjacent street traffic. Following is a summary of TPD's findings:

Traffic Impact

It is TPD's understanding that, during the weekday evenings, the newly-lighted fields are anticipated to be utilized by outside organizations, as well as Westtown School, primarily as practice space. These practices most likely will occur outside the weekday P.M. peak hour. However, to be extremely conservative for this assessment, TPD assumed the following times of operation:

- Practice sessions will occur between 5:30-10:00 P.M.
- Parents arrive for drop-off up to approximately 30 minutes before each session (first session drop-off approximately 5:00-5:30 P.M.)
- 50% of Parents drop-off and leave at the beginning of each session
- Assumed no carpooling
- Assumed no multi-child families
- Parents arrive for pickup approximately 15 minutes after each session (first session pickup approximately 7:00-7:15 P.M.)
- 50% of Parents arrive and pick-up at the end of each session
- There will be overlap between pick-up and drop-off between sessions

It is anticipated that, based on the overlap between pick-up and drop-off, the time between sessions will experience the most site-related traffic to/from the newly-lighted fields. However, all of these overlap periods will be brief and will occur outside of the peak hours of adjacent street traffic (first overlap approximately 7:00-7:15 P.M.).

It is TPD's understanding that, the anticipated use of the newly- lighted fields could be for Travel Soccer Clubs, Travel Lacrosse, Field Hockey, etc. Based on conversations with the Project Team, TPD assumed the following for each potential use:

- Travel Soccer
 - Half-field practices are assumed. Therefore, four (4) teams per session assumed
 - 15 players and 2 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:
 - Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 68 / Exit = 30
 - End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 30 / Exit = 68
 - Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 68 / Exit = 30
 - **Overlap between Sessions = Enter = 83 / Exit = 64 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**
- Travel Lacrosse
 - Full-field practices are assumed. Therefore, two (2) teams per session assumed
 - 18 players and 2-3 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:
 - Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 42 / Exit = 18
 - End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 18 / Exit = 42
 - Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 42 / Exit = 18
 - **Overlap between Sessions = Enter = 51 / Exit = 39 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**
- Field Hockey
 - Full-field practices are assumed. Therefore, two (2) teams per session assumed
 - 15 players and 2-3 coaches assumed for each team
 - Therefore, the anticipated traffic generation would be:

- Beginning of Session (1st Session: 5:00-5:30 P.M.) = Enter = 36 / Exit = 15
- End of Session (1st Session: 7:00-7:15 P.M.) = Enter = 15 / Exit = 36
- Beginning of Session (2nd Session: 7:00-7:30 P.M.) = Enter = 36 / Exit = 15
- **Overlap between Sessions = Enter = 44 / Exit = 33 (1/2 end of 1st Session plus all of 2nd Session assumed to overlap)**

As shown in the assumptions above, the scenario assuming the use of the newly-lighted fields for Travel Soccer, during the overlap between sessions, results in the most conservative in terms of trip generation (highest traffic flow), with a maximum of 83 vehicles entering or exiting.

It is TPD's opinion that based on the above extremely conservative assumptions, there will be minimal impact associated with this assumed new use since it will occur during the overlap of sessions, which occurs outside the peak hours of adjacent street traffic. Additionally, it is important to note that these "new" vehicle trips will be dispersed over the 2-3 site driveways at the existing Westtown School. Furthermore, PennDOT Average Daily Traffic (ADT) Data for the adjacent roadways are as follows:

- Westtown Road (S.R. 2007)
 - ADT = 3,200 vehicles per day (vpd)
 - Maximum Hourly Bi-Directional Volume during the Weekday P.M. = 512 vehicles (Sept 2015)
- Shady Grove Way
 - ADT = 1,369 vpd
 - Maximum Hourly Bi-Directional Volume during the Weekday P.M. = 173 vehicles (Oct 2016)

Based on the volumes shown above for Westtown Road (S.R. 2007) and Shady Grove Way, it is TPD's opinion that the anticipated trip generations listed above will not cause an impact at the existing site driveways or surrounding roadway network.

For comparison purposes, TPD performed trip generation counts at the United Sports Training Center (USTC) located in West Bradford Township during a Saturday tournament (soccer/lacrosse) in July 2014. During that tournament, eleven (11) fields were in use. TPD calculated a trip generation of 31.55 trips/field, which is less than 50% of what was assumed for purposes of this analysis. Therefore, TPD's data shows the trips/field assumed for this project are higher than those likely to be experienced. UTSC Trip Generation Data is attached for reference.

Parking Demand

*Based on a review of the Conditional Use Site Plans, a parking supply of 84 parking spaces will be provided in the immediate vicinity of the two (2) newly-lighted fields. Based on the trip generations laid out above, TPD anticipates a maximum parking demand of 83 vehicles (highest directional traffic assuming Travel Soccer use with 100% retention during practice). This parking supply provides a parking surplus. Furthermore, the plan shows an additional 76 existing parking spaces available within walking distance located near the adjacent existing athletic fields, with additional parking fields located within the school campus. **Therefore, it is TPD's opinion that the parking shown on the Conditional Use Plans is more than adequate, especially since the peak nighttime parking of these fields will not overlap with the routine parking demand of the rest of the campus.***

Internal Circulation

Based on a review of the Conditional Use Site Plans, access to the newly-lighted fields will be provided from Oak Lane at three (3) locations: Western Driveway, Central Driveway and Eastern Driveway. All three (3) driveways, in addition to the internal drive aisles, will provide adequate width for two-way flow. The plan also depicts a cul-de-sac at the western portion of the plan that can be utilized for vehicle turn around. There are two (2) drop-off areas located on the plan, separate from the provided parking spaces, to allow for the pick-up/drop-off activity described previously in this letter.

We hope that these responses are helpful. If you require additional information please feel free to contact us.

Sincerely,
TRAFFIC PLANNING AND DESIGN, INC.



Matthew I. Hammond, P.E.
Executive Vice President

mhammond@trafficpd.com

Attachment: USTC Trip Generation Data

cc: George Schaab, Westtown School
Paul Lehmann, Westtown School
Mark DeNegro, Westtown School
Jason Best, ELA Group, Inc.
Charles Haley, ELA Group, Inc.
Mike Rufo, Anchor Management Group
Gary Holloway, Jr.
TPD File



WESC.00003

USTC - 2014 Counts - 11 Fields During Tournaments

Wednesday, July 9, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
7:00	0	1	0	0	0	0	0	0	1	0	1	29
7:15	6	2	0	0	0	0	0	0	8	0	8	38
7:30	3	3	4	5	0	0	0	0	6	9	15	44
7:45	3	1	0	1	0	0	0	0	4	1	5	68
8:00	2	5	2	1	0	0	0	0	7	3	10	175
8:15	9	2	1	2	0	0	0	0	11	3	14	
8:30	19	10	2	8	0	0	0	0	29	10	39	
8:45	44	19	21	28	0	0	0	0	63	49	112	
PEAK HOUR	74	36	26	39	0	0	0	0	110	65	175	

Trips/Field = 15.91
Enter% = 62.9%

Tuesday, July 8, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
4:00	7	6	13	19	0	1	0	0	14	32	46	86
4:15	4	1	1	6	0	0	0	0	5	7	12	61
4:30	3	2	1	4	0	0	0	0	5	5	10	94
4:45	9	4	2	3	0	0	0	0	13	5	18	125
5:00	8	6	6	1	0	0	0	0	14	7	21	160
5:15	14	17	6	8	0	0	0	0	31	14	45	
5:30	16	10	6	9	0	0	0	0	26	15	41	
5:45	23	17	14	9	0	0	0	0	40	13	53	
PEAK HOUR	61	50	22	27	0	0	0	0	111	49	160	

Trips/Field = 14.55
Enter% = 69.4%

Saturday, July 19, 2014

TIME	Marshallton-Thorndale Driveway				Boulder Road Driveway				TOTAL SITE			
	LI	RI	LO	RO	LI	RI	LO	RO	ENTER	EXIT	TOTAL	PEAK
11:00	25	34	34	28	1	0	0	6	60	68	128	347
11:15	14	24	41	31	1	0	0	0	39	72	111	329
11:30	11	17	15	13	1	0	1	3	29	32	61	280
11:45	15	18	10	3	1	0	0	0	34	13	47	259
12:00	9	6	67	25	0	0	0	3	15	95	110	253
12:15	7	12	36	5	1	0	0	1	20	42	62	
12:30	8	7	18	6	0	0	0	1	15	25	40	
12:45	11	10	12	8	0	0	0	0	21	20	41	
PEAK HOUR	65	93	100	75	4	0	1	9	162	185	347	

Trips/Field = 31.55
Enter% = 46.7%