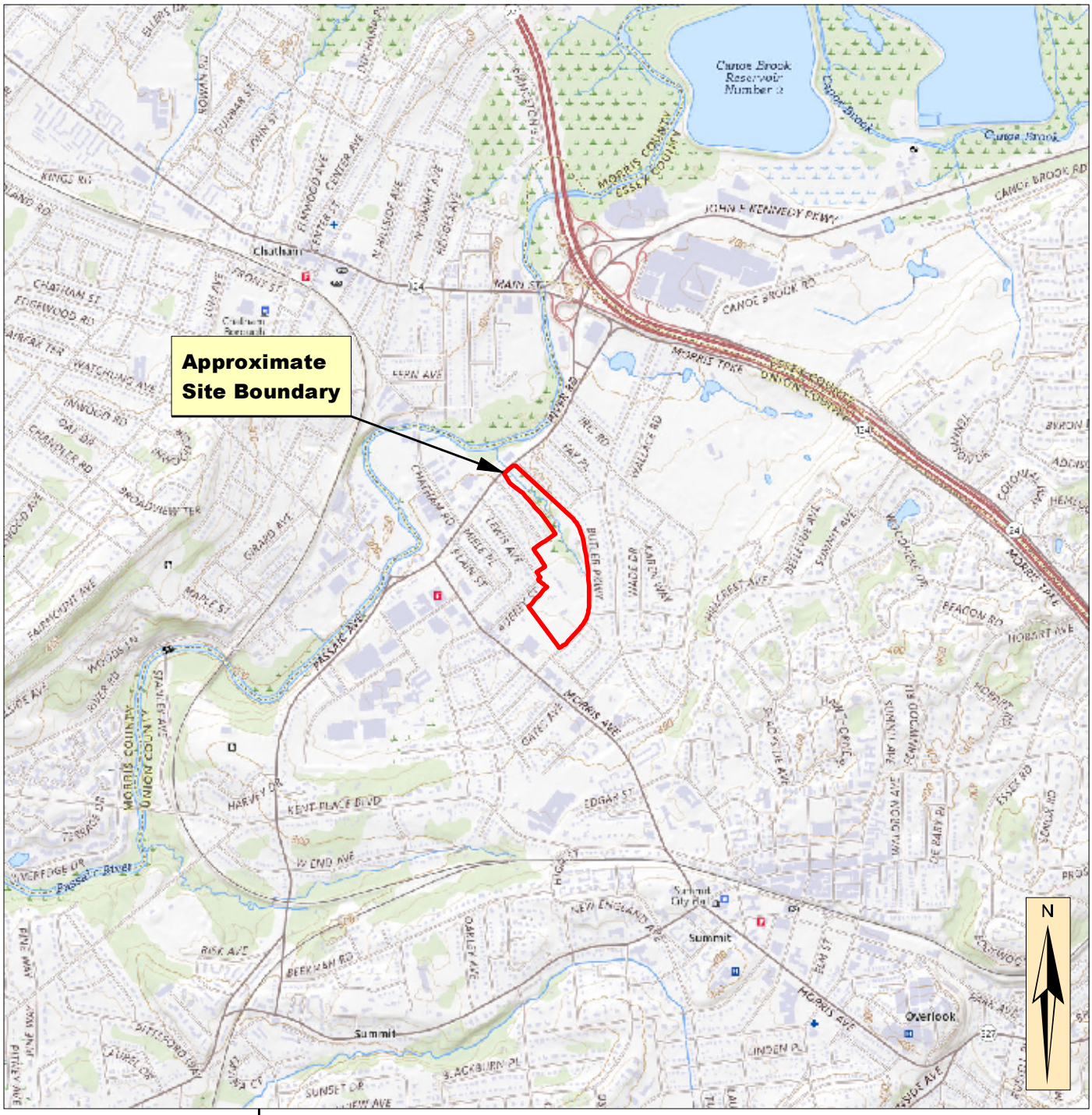
ATTACHMENT A

Figures



0 2,000 4,000 Feet

SITE
LOCATION

State Plane Coordinates (New Jersey NAD 83)
527,778' E; 690,690' N

FIGURE 1: USGS SITE LOCATION

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

USGS The National Map. Roselle, NJ Quadrangle. 2022.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:24,000

F:\Jobs2024\EN24-133\GIS\Projects\USGS.mxd

Legend

Approximate Site Boundary

Streams

0 700 1,400 Feet

FIGURE 2: 2020 AERIAL IMAGERY

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

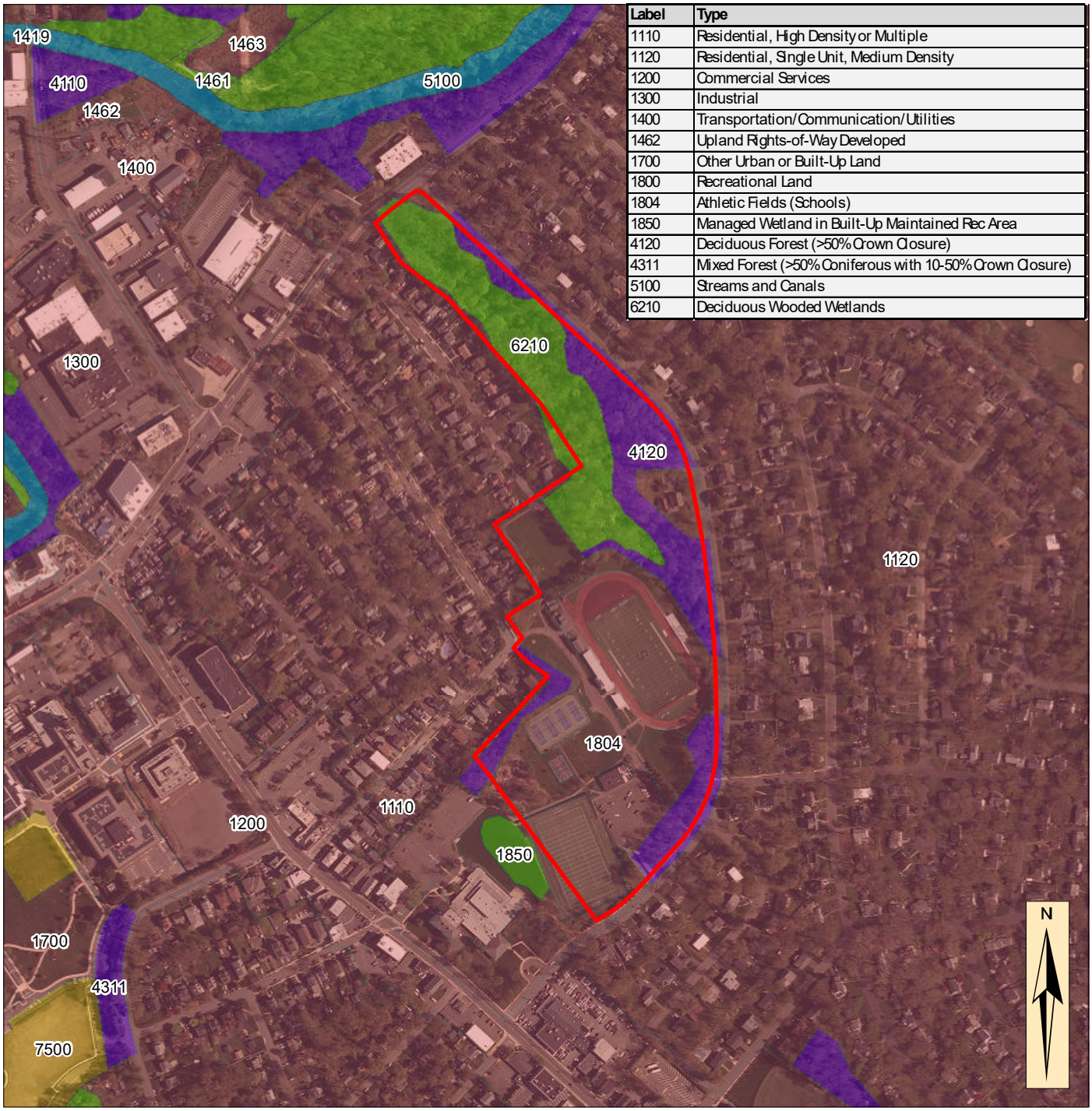
Source: NJOIT, OGIS. 2021. NJ 2020 High Resolution Orthophotography.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:8,400

F:\Jobs2024\EN24-133\GIS\Projects\Aerial.mxd



Label	Type
1110	Residential, High Density or Multiple
1120	Residential, Single Unit, Medium Density
1200	Commercial Services
1300	Industrial
1400	Transportation/Communication/Utilities
1462	Upland Rights-of-Way Developed
1700	Other Urban or Built-Up Land
1800	Recreational Land
1804	Athletic Fields (Schools)
1850	Managed Wetland in Built-Up Maintained Rec Area
4120	Deciduous Forest (>50% Crown Closure)
4311	Mixed Forest (>50% Coniferous with 10-50% Crown Closure)
5100	Streams and Canals
6210	Deciduous Wooded Wetlands

Approximate Site Boundary

2020 Land Use/Land Cover

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

0 400 800 Feet

FIGURE 3: 2020 LAND USE/LAND COVER

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

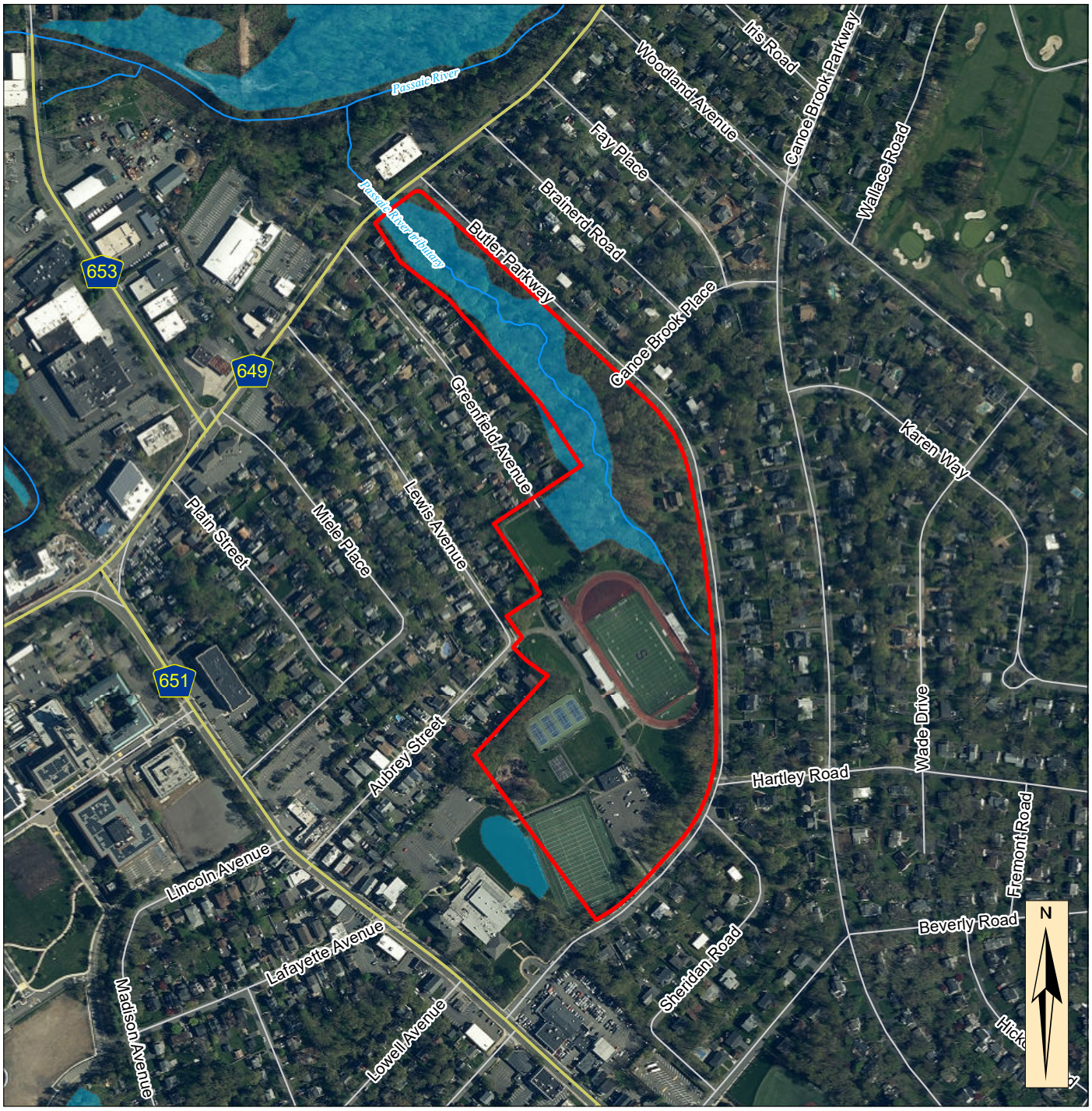
Sources:
NJDEP. 2023. Land Use/Land Cover 2020 Update, Edition 20231121.
NJOIT, OGIS. 2021. NJ 2020 High Resolution Orthophotography.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:6,000

F:\Jobs2024\EN24-133\GIS\Projects\2020_LULC.mxd



Approximate Site Boundary

NJDEP Mapped Wetlands

Streams

0 700 1,400 Feet

FIGURE 4: NJDEP WETLANDS

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

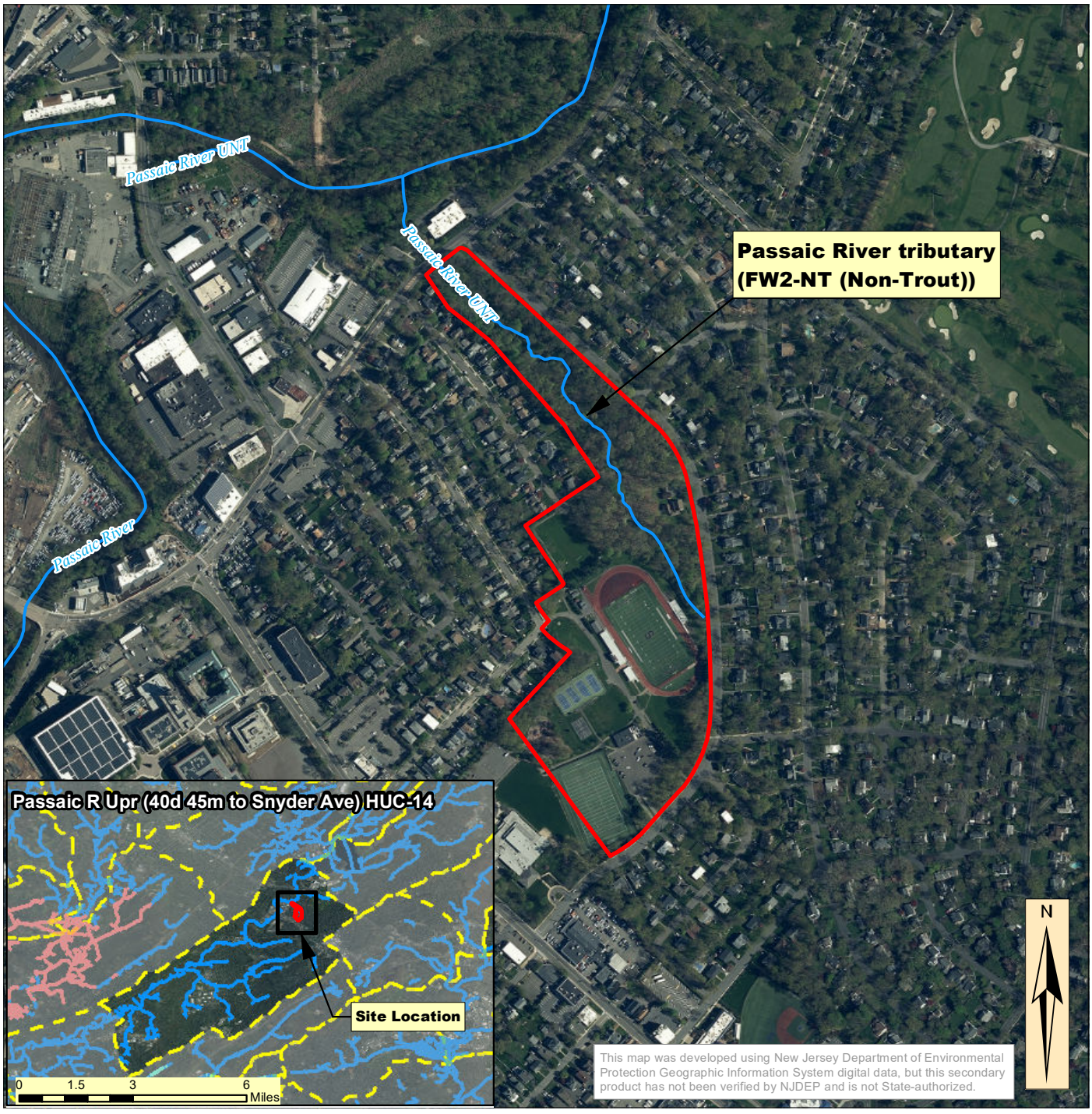
Source: NJOIT, OGIS. 2021. NJ 2020 High Resolution Orthophotography.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:6,000

F:\Jobs2024\EN24-133\GIS\Projects\NJDEP Wetlands.mxd



Approximate Site Boundary
Trout maintenance waters
Trout production waters
C1 - Category One waters
C2 - Category Two waters
ONRW - Outstanding National Resource Waters
HUC 14 boundary

0 500 1,000
Feet

FIGURE 5: SURFACE WATER QUALITY

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

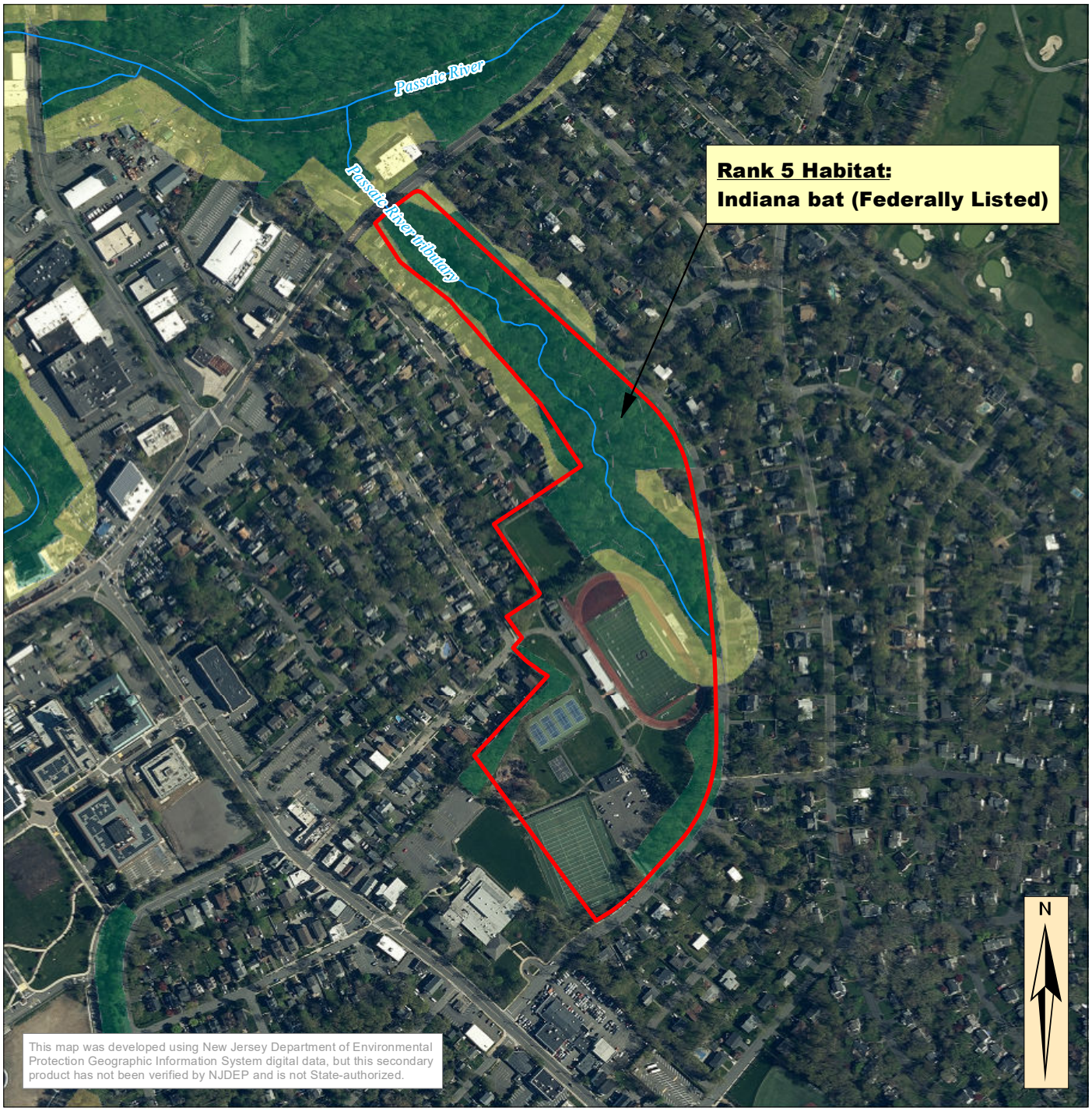
Sources:
NJDEP. 2020. NJDEP Surface Water Quality Standards of New Jersey, Edition 20200327.
NJOIT, OGIS. 2021. NJ 2020 High Resolution Orthophotography.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:7,200

F:\Jobs2024\EN24-133\GIS\Projects\swq.mxd



Approximate site boundary

Species-Based Habitat

RANK

- Rank 1 - Habitat specific requirements
- Rank 2 - Special Concern
- Rank 3 - State Threatened
- Rank 4 - State Endangered
- Rank 5 - Federal Listed

Vernal Pools/Habitat

VERNAL POOL STATUS

- Vernal pool location
- Potential vernal pool location

VERNAL HABITAT TYPE

- Potential vernal habitat area
- Vernal habitat area

Freshwater Mussel Habitat

RANK

- Rank 2 - Special Concern
- Rank 3 - State Threatened
- Rank 4 - State Endangered
- Rank 5 - Federal Listed

0 500 1,000 Feet

FIGURE 6: LANDSCAPE PROJECT 3.3

Tatlock Sports Complex
Block 401, Lot 1
City of Summit
Union County, New Jersey

Sources:
NJDEP, DFW, ENSP. 2017. New Jersey's Landscape Project (Version 3.3).
NJOIT, OGIS. 2021. NJ 2020 High Resolution Orthophotography.

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

Date: 10/10/24

Scale 1:6,000

F:\Jobs2024\EN24-133\GIS\Projects\Landscape.mxd

ATTACHMENT B

Pertinent Correspondence

EcolSciences, Inc.
Environmental Management & Regulatory Compliance

SPORTS LIGHTING

Answers to 9 common QUESTIONS

With bonus LED Retrofit Information

musco Lighting

We Make It Happen®

Contents

Decisions . . .

When it comes to sports lighting, there are a lot of them. It's a big investment, and the decisions you make now can affect your community for the next 20 or 30 years.

The priorities are clear and consistent—it must be cost effective, trouble free, energy efficient, avoid maintenance headaches, and minimize the impact of spill and glare on neighbors.

Above all, you want the most value possible from the dollars you spend and field lighting that will be a source of pride for years to come.

The following are answers to the most common questions about sports lighting, so you can make the most informed decisions possible.

Common Questions

RETROFITS

Thinking of retrofitting your old lighting?

Watch for the green text blocks for information specific to upgrading your lights while using existing structures and underground electrical supply.

1. Should I retrofit with LED?

For many years, metal halide was the typical light source used for sports lighting. Replacing existing metal halide with light-emitting diode (LED) technology can deliver many benefits, provided it's supported by a well-designed system of light control, structures, electrical and application.

Light Levels

As metal halide lighting ages, it's likely that on-field light levels decrease which can eventually affect safety and playability. Relamping and cleaning fixtures may recover some lost light. Retrofitting with LED can also improve light levels, but just swapping out your old lights with LED fixtures will not guarantee the light levels you need. The best way to ensure adequate light levels is by having photometric designs done prior to installation so there are no surprises.

Spill & Glare

Sports lighting is unique in that it requires high quantity of light projected over long distances in a way that avoids impacting the neighborhood and meets the differing viewing needs of players, fans, and often video broadcasts. The LED light source has the potential for extreme cut-off. However, if not properly controlled, the intensity of the multiple tiny light sources also has a greater risk of creating uncomfortable glare and spill light.

Energy Efficiency

LED can reduce energy consumption by as much as 80 percent compared to older light sources. And the instant on/off capabilities of LED also ensures a more energy efficient operation, as does the ability to dim LED lights and operate them at less than full power so you can tailor usage for multiple uses such as events, practices, and clean up.

Return On Investment

Most indoor sports facilities are used almost daily, so the energy savings with LED generally pay back the cost of retrofitting in just a few years. Outdoor recreational facilities are often used less than 500 hours per year. At 10 cents per kilowatt hour, the energy cost to light a youth soccer field with metal halide is less than $2 per hour. In this case, return on investment through energy savings for an LED retrofit would take several years.

Warranty

Evaluate how retrofitting your existing lighting will impact the current warranty and services being provided by the original manufacturer. In some cases, you might still have several years of coverage that could become void if the equipment is modified. Automated on/off control service systems may also be impacted. If your warranty is expired, retrofitting may be a great way to extend your light level guarantee and coverage for parts and labor.

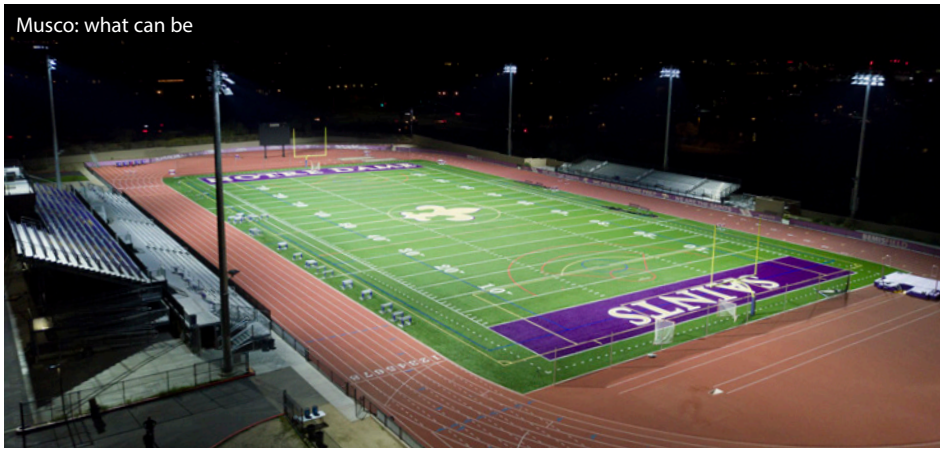
Add Entertainment Features

The instant on/off capabilities of LED enables well-designed system controls and special effects packages to present exciting light shows for team and game celebrations. These may include features such as light-to-music synchronization and color-changing Red-Green-Blue-White (RGBW) technology.

"Two aspects of energy efficiency are important to consider: the efficiency of the LED device itself (source efficacy) and how well the device and fixture work together in providing the necessary lighting (luminaire efficacy)."

— Source: U.S. Department of Energy, http://energy.gov/eere/ssl/led-basics

Light control matters



2017 · Retrofit with Musco TLC for LED® technology
Notre Dame Preparatory High School, Scottsdale, Arizona, USA

2016 · Other manufacturer's fixture with LED light source after an attempt to resolve glare complaints
Notre Dame Preparatory High School, Scottsdale, Arizona, USA

RETROFITS

Musco can help you evaluate the benefits and considerations for retrofitting your existing lighting.

2. How much will it cost to install my lights?

Every field is unique, and there are many things that impact the cost. The fixtures are only a small part of overall project cost, which can be broken into two categories: initial, and operating (or life-cycle) costs.

The initial cost of installing your project includes three components:

- Lighting
- Structural
- Electrical

For each of these three components, you will need to select someone to:

- Design
- Supply
- Install

Decisions you make in one area will affect the others. For example, variances in fixture efficiency will affect the number of fixtures needed and, as a result, could require larger poles to operate the system. Your choices in these areas will also impact operating and maintenance costs.

The following chart can be used to ensure all nine of these important decisions are covered.

9 Important Sports-Lighting Decisions

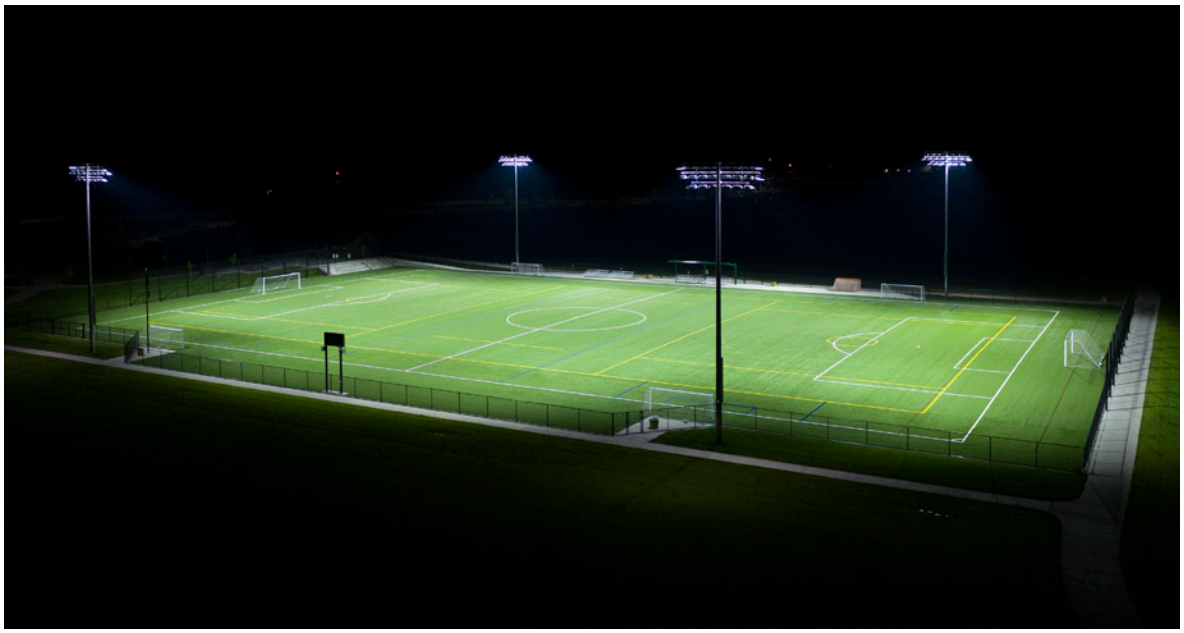
	LIGHTING	STRUCTURAL	ELECTRICAL
DESIGN	?	?	?
SUPPLY	?	?	?
INSTALL	?	?	?
	OPERATE		

RETROFITS

On retrofit projects, using your facility's existing poles and electrical system can be a great way to reduce cost. Just be sure these components are evaluated for integrity, and you'll want to make sure the new lights work as an integrated part of the overall system design to achieve the best possible results.

As you work through these decisions, it's important to keep in mind a number of variables will affect the design and costs of your project. Here's a checklist of things to discuss with your sports lighting representative:

Quantity and Quality of Light	Geographical Issues	Environmental Light Control Issues	Lighting Usage
☐ Facility type and size	☐ Location — structural and local/state building codes	☐ Proximity of neighbors	☐ Anticipated hours of operation
☐ Players' skill level	☐ Soil conditions	☐ Community light ordinances	☐ Local initiatives for reducing energy usage
☐ Seating capacity	☐ Existing structures	☐ Nearby airports or observatories	☐ Desire for dimming or special effects
☐ Television/video broadcast requirements	☐ Pole setback requirements	☐ Multi-field complexes	
☐ Lighting standards (for organizations such as Little League Baseball®)			



Musco provides FREE project planning assistance to help you navigate the decisions that impact project cost. Our foundation-to-poletop systems and retrofit systems incorporate lighting, structural, and electrical components.

3. How many lights do I need?

When it comes to how much light you need, don't think about it in terms of number of fixtures. What you're really buying is quantity and quality of light on your field. With LED sports lighting, the quantity and quality of light is determined largely by the efficiency of reflector systems, light sources, and application expertise — all of which vary greatly based on the experience of your manufacturer.

Quantity of light

On-field lighting is measured in footcandles or lux. The amount of footcandles/lux required for your field is determined by:

1. **Sport Type —** more light is needed for sports that use smaller, faster-moving objects (balls, pucks, skeet, etc.)
2. **Skill Level —** higher light levels are needed for sports being played at higher skill levels to account for increased speed and gameplay accuracy.
3. **Field Size —** the size of the playing area defines the number of square feet/meters that need to be lighted.
4. **Seating Capacity —** the more seating your field has, the farther away some of the spectators will likely be, requiring more lighting to see the action on the field.
5. **Video Broadcast Requirements —** a camera interprets images slower than the human eye and requires more light to be able to follow the action. Broadcasts include closeups of players during critical portions of an event and broadcasters often want the greatest depth of view possible.

Achieving and maintaining the right quantity and quality of light impacts tournament site selection.

RETROFITS

Simply swapping LED fixtures in for your existing lights on a 1:1 basis may not achieve necessary light levels or uniformity, and could lead to serious problems with glare and spill light.

Quality of light

Quality of light is referred to as uniformity or evenness on the playing surface. It's often stated as a ratio, such as 3:1, the minimum standard for most sports. This means the brightest point on the field should be no more than three times as bright as the darkest point. This ratio is important because a ball can appear to change speed as it passes from dark to light areas, making it difficult for players to safely track the ball's flight.

Initial vs. Target Light Levels

Light levels depreciate over time as the light source ages and dirt builds up on the fixture. How fast it depreciates depends on the fixture design, light source type and how it's operated. Initial light levels refer to how much light is on your field immediately upon installation, while target (or maintained) light levels refer to what you can expect over the life of your system. Each manufacturer bidding on your project should provide specific information on target light levels, as well as a uniformity ratio. This will ensure they're all designing to the same criteria when you're comparing proposals. You should also get written guarantees for the quantity and quality of light your system will provide.

Generally Accepted Lighting Standards

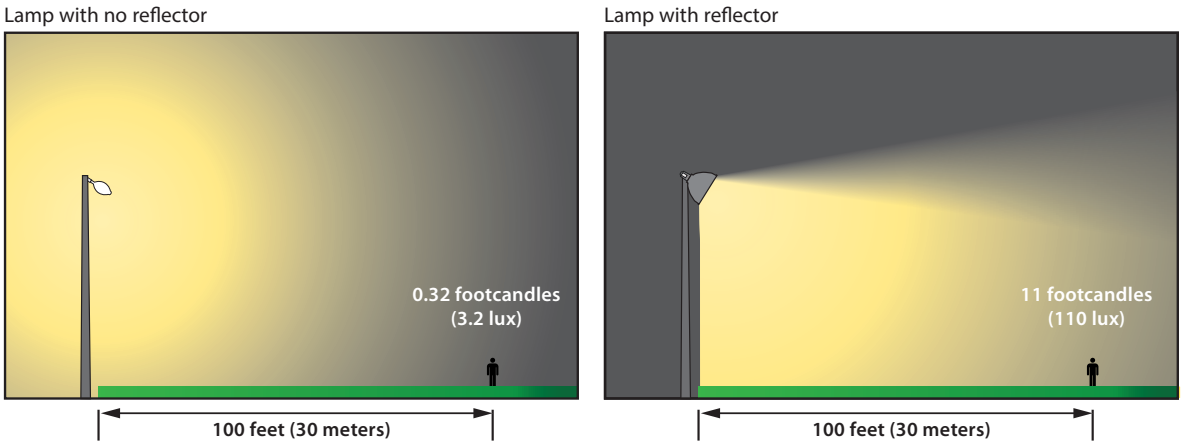
Sport	Sport Level	Seating Capacity	Footcandles	Lux
Baseball / Softball	Recreational	Limited or none	30/20	300/200
	Schools / Leagues	Up to 2000	50/30	500/300
	Schools / Leagues / Semi-Pro	Up to 5000	100/70	1000/700
Basketball (indoor)	Recreational	Limited or none	30	300
	Schools / Leagues	Up to 2000	50	500
	Schools / Leagues / Semi-Pro	Up to 5000	75	750
Football	Recreational	Limited or none	20	200
	Schools / Leagues	Up to 2000	30	300
	Schools / Leagues / Semi-Pro	Up to 5000	50	500
	Schools / Leagues / Semi-Pro	Over 5000	100	1000
Soccer	Recreational	Limited or none	20	200
	Schools / Leagues	Up to 2000	30	300
	Schools / Leagues / Semi-Pro	Up to 5000	50	500
Tennis – 2 court (side by side)	Recreational	Limited or none	30	300
	Schools / Leagues	Up to 2000	50	500
	Schools / Leagues / Semi-Pro	Up to 5000	75	750

Based on IES Recommended Practice: Lighting Sports and Recreational Areas RP-6-20. For larger facilities, please contact Musco.

Musco provides FREE photometric design and computer modeling services to you or your consultant to help you achieve guaranteed light quantity and quality on your field.

4. If they use the same wattage, aren't all LED fixtures the same?

No. The manufacturer's reflector design and application expertise determine how effectively the light energy is projected onto the playing surface. Technology allows wasted spill light to be redirected back onto the playing surface, increasing light on the field.



Same Light Source, Different Results

It's a common mistake to specify a number of fixtures rather than the quantity of light delivered to the field. Specifying a set number of fixtures simply spells out the amount of light that will be generated by the fixture at the top of the pole, not the amount of light on the field.

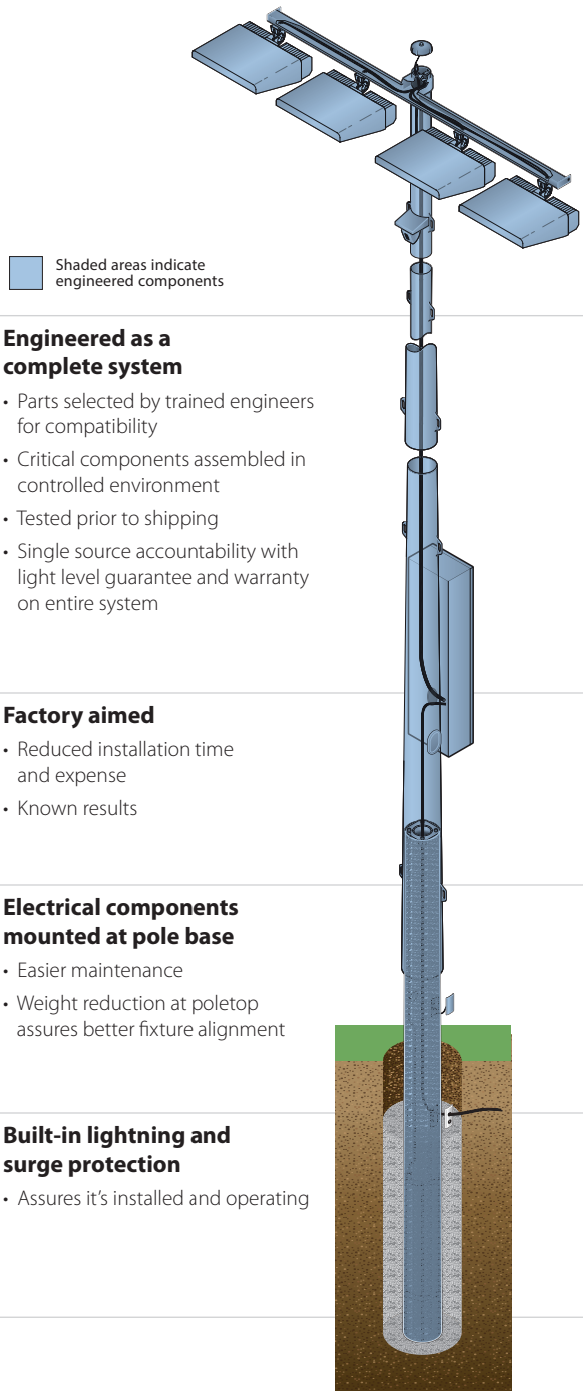
In the illustration above, the fixture produces the same amount of light at the poletop. Without a reflector, it projects less than one footcandle (10 lux) onto an area 100 feet (30 meters) away. With a basic reflector it projects 30 times that amount, redirecting what would otherwise be wasted spill light onto the field.

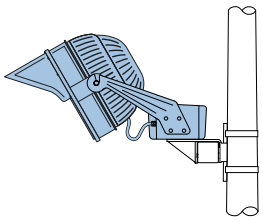
RETROFITS

There are big differences in efficiency of LED luminaires used for sports lighting. Make sure to evaluate the on-field performance to ensure you get the light levels you need.

System vs Parts

Sports lighting may be purchased as a complete system, or as a single fixture that must then be matched up with parts and pieces from a variety of sources. Here's an analysis:





Engineered as a complete system

- Parts selected by trained engineers for compatibility
- Critical components assembled in controlled environment
- Tested prior to shipping
- Single source accountability with light level guarantee and warranty on entire system

Parts and pieces of unknown strength and quality put together by the installer

- Inconsistent warranties from several sources
- Exposed wiring creates maintenance problems

Factory aimed

- Reduced installation time and expense
- Known results

Individual fixture-by-fixture aiming from the top of the pole

- Adds installation time and cost
- Unknown results

Electrical components mounted at pole base

- Easier maintenance
- Weight reduction at poletop assures better fixture alignment

Electrical components on fixture

- Troubleshooting must be done from the top of the pole
- Increases chance of misalignment

Built-in lightning and surge protection

- Assures it's installed and operating

Unknown protection

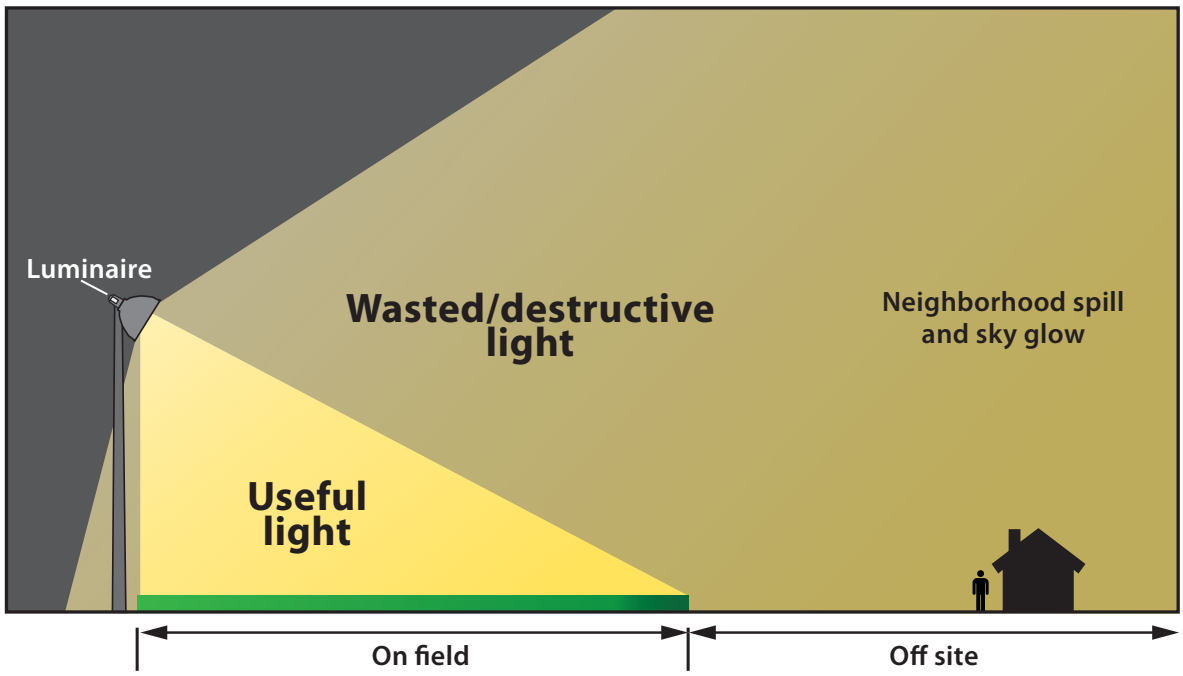
Musco's complete system is engineered from foundation to poletop in 5 Easy Pieces™ for optimal light control, easy installation, and trouble-free operation.

5. Why should I be concerned with spill light and glare?

The ability to effectively control spill light and glare is critical for a number of reasons.

Spill Light is Wasted Energy

Fixtures with poor light control waste light by allowing it to go off the field into neighborhood spill and sky glow. Proper light control redirects wasted spill light back onto the playing surface. Efficient fixture and system design, along with application expertise, will reduce the number of fixtures needed to get useful light onto the field. This can also significantly cut the energy consumption and carbon footprint at your facility.

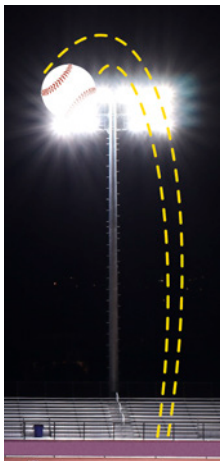


RETROFITS

Planning a retrofit in which new LEDs are swapped in for old fixtures on a 1:1 basis can lead to serious problems with glare and spill if the fixture is not properly designed. Since LED involves hundreds of tiny light sources instead of one large one, effectively controlling the light being emitted is more challenging.

Impact on Players and Fans

Due to the intensity of the LED light source, increased measures should be taken to provide optic controls that minimize glare. Poorly designed fixtures create excessive glare, making it difficult for fans to follow the action and for players to follow the ball, creating the possibility for injury. Players competing on multi-field complexes can also be affected by glare from adjacent fields.



Glare impacts players

Musco gets the glare out of the players' eyes

Impact on Neighbors

Neighboring homes and businesses can be significantly impacted if your lights create glare and/or spill that disrupt their evening hours. Some schools and organizations have even been forced to leave their lights off by homeowners associations and municipalities until they resolve problems with glare and spill.

There's a growing concern for wasting energy and for limiting the impact of light pollution. Many communities are enacting environmental light pollution ordinances to keep wasted light from impacting roadways, astronomical research facilities, and nearby wildlife habitats.

Community Growth

Even if there aren't currently homes in the immediate area around your facility, that could change. Communities often grow around sports facilities, and your lighting system should last 20 years or more. By minimizing spill light and glare now, you'll ensure happy neighbors when they do arrive and receive fewer complaints in the future.

Musco has been evolving its advanced glare and spill control technology for over four decades, and has nearly two dozen patents focused on better light control.

6. Why does pole type and height matter?

Poles are an integral part of a lighting system. The right poles help ensure proper aiming, long-term reliability, and reduced maintenance expense.

Pole Types

Pole Type	Benefits	Drawbacks
Wood	• Low cost of material	• Poles not tall enough to allow proper mounting height • Fixture misalignment because wood twists and leans over time • Safety hazards: rotting wood, exposed electrical conduit, toxic preservatives
Concrete	• Can be direct buried, eliminating the cost of footings • Corrosion and moisture resistant • Pleasing appearance	• Poles are heavier and more expensive to set • High freight costs often limit their use to areas near concrete pole manufacturing plants
Base-plate Galvanized Steel	• Pleasing appearance • Lighter weight than concrete, easy to handle	• Higher initial cost • Require construction of concrete foundation with anchor bolts to mount poles and sufficient curing time for concrete • Curing time of concrete base • Corrosion at ground level • Difficulty with pole orientation
Direct Burial Galvanized Steel	• Pleasing appearance • Lightweight	• Underground corrosion accelerated due to moisture and soil chemicals (often undetectable prior to pole failure) • Unpredictable life expectancy • Increase installation time and cost depending on structural engineer's criteria

Combination Concrete and Steel Pole

There are also combination concrete and steel poles, which offer the advantages of steel and concrete without many of the drawbacks. Well-designed steel and concrete poles can help simplify installation, save costs, and reduce concerns about corrosion at and below ground level.

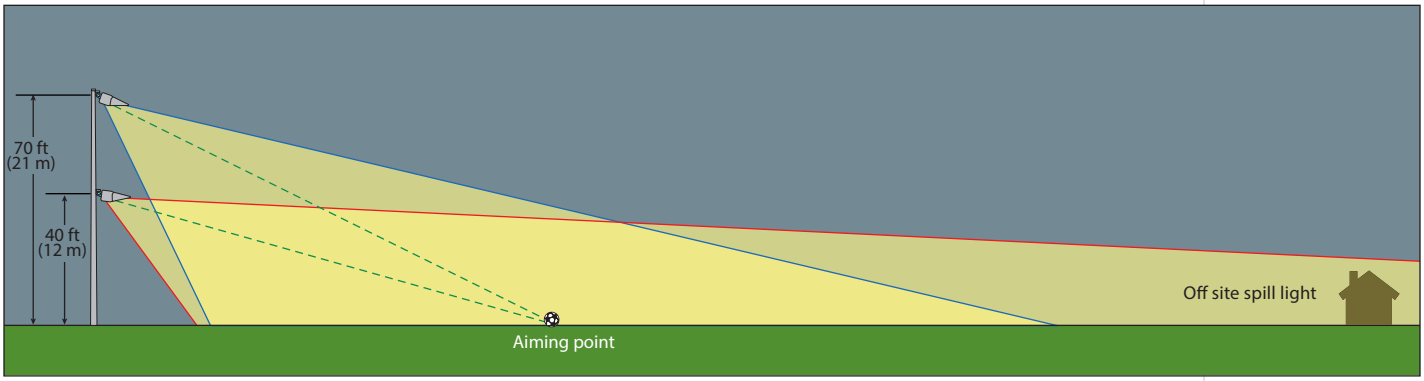
Musco's Light-Structure System™ combines the benefits of both concrete and steel poles.

RETROFITS

Among the first steps of any LED retrofit project is to examine your existing poles to ensure structural reliability. Even if your poles are structurally sound, you should check your poletop mounting structures as well to determine if new crossarms are needed.

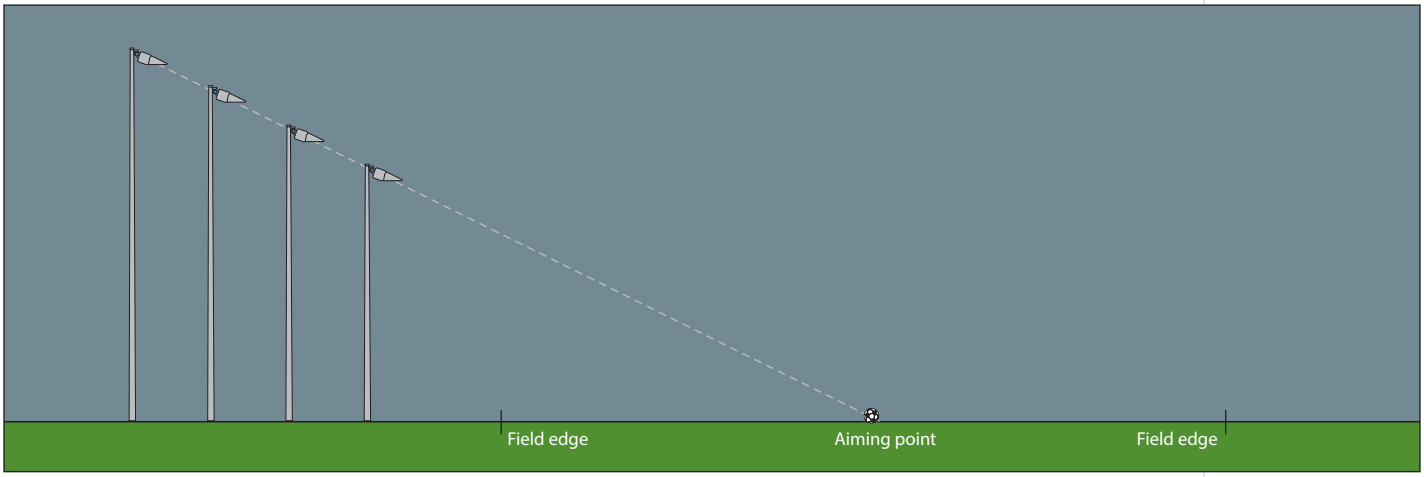
Pole Height

Pole height impacts aiming angles, which directly affect the evenness of light distribution across the field and the potential for spill light pollution. Normally, taller poles allow fixtures to be aimed more directly down onto the playing surface, reducing the amount of light spilling into unwanted areas. In some cases, city ordinances or other factors require the use of shorter poles, a challenge that experienced manufacturers can typically resolve with customizations like additional poles or creative aiming strategies to achieve your lighting goals on and off the field.



Pole Distance

The optimal height of the poles needed for your lighting system and resulting project cost is also affected by their distance from the playing surface. Structures such as bleachers and buildings will impact pole location and resulting distance from the field. Future expansions or other facility plans should be discussed with your lighting manufacturer.



Musco's expert project managers and engineers will work with you to design the ideal lighting system for your specific needs.

7. How much will it cost to operate my lights?

The cost to operate your lights can be broken out into four categories:

Electrical Costs

Electrical cost to operate lights is less than many think. Light sources vary in how efficiently they convert electrical energy into light energy. LED can cut energy consumption by as much as 80 percent. However, your hours of usage will determine how much you could save on annual energy cost. Here's an example:

Standard soccer field — 360 x 225 ft (110 x 69 m), 30 footcandles (300 lux)

	Musco		Other Manufacturer
	TLC for LED® Technology	1500 W Metal Halide	1500 W Metal Halide
Fixtures required	24	32	52
Hourly energy cost	$3.02	$5.00	$8.42
Annual energy cost	$1,510	$2,502	$4,212
25-year energy cost	**$37,750**	**$62,560**	**$105,300**

Assumes 10¢ per kW·h electrical rate, 500 hours per year operation

Staffing Costs

As public concern for energy conservation grows and budget constraints impact staffing, automated control systems can help keep those costs in check. Automated systems are more reliable than timers, better accommodate last-minute changes, save energy, and eliminate staff travel to fields to turn lights on and off.

Some systems provide reports that track hours by user, helping you set user fees to offset operating costs. Monitoring services are also available to ensure on/off schedules are completed and provide alerts to you or your warranty provider for fixture outages that may affect playability.

Routine Maintenance Costs

Older metal halide light sources required group relamping prior to end of lamp life to maintain target light levels on the field. LEDs used for sports lighting should not burn out before the end of system life, provided there is adequate design for the supporting structural and electrical components.

Regardless of light source technology, the basics of lighting maintenance remain the same: cleaning, monitoring, aiming alignment, and troubleshooting. Fuses will need to be replaced as needed. You may need to rent equipment if the electrical components such as fuses and drivers are not accessible at ground level.

Costs include:

- Equipment rental to get to top of pole ($75 to $150 per hour)
- Labor (approximately $60 - $100/hour average)

RETROFITS

LED is not maintenance free. Find out if your manufacturer includes parts, shipping, onsite labor and lift equipment. Electrical components located remotely near the base of the pole, so routine servicing can be done from a step ladder, eliminate the expense of a crane or lift to reach drivers or fuses located in the fixtures.

Unexpected Repair Costs

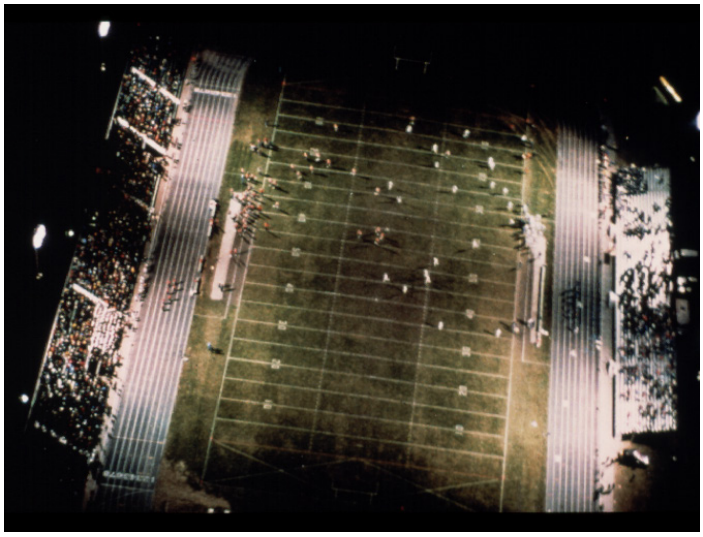
Unexpected repairs can take significant time and money to fix. A well-designed system will be durable enough to withstand the elements and have features designed to reduced unexpected costs.

Re-aiming — make sure your manufacturer guarantees fixture alignment. Over time, factors like weather can cause misalignment resulting in less light on the field. Labor and equipment cost to correct this can be significant.

Fixture outages — Each driver or fixture should be individually fused. This minimizes multiple or "gang" failures. If your manufacturer does not include labor for fixture repairs, you will be responsible for lift and labor to remove and ship a fixture in for repair or replacement. Upon return, you will need to reinstall the new fixture.

Troubleshooting — Easy-to-access systems have electrical components such as ballasts/drivers, capacitors, and fuses located close to the ground to save time and money.

Lightning and surge protection — Built-in lightning grounding and surge protection helps avoid equipment damage. This is especially critical with the electronics involved in LED lighting.



Misalignment of as little as 10 degrees shifts light off the playing field into the stands.

Having major electrical components accessible at ground level avoids hiring a $100/hour crane to replace a $10 fuse.

Musco's systems are efficient, include automated controls, can be turned on/off instantly with the touch of a phone, are proactively monitored with 24/7 call-center support, and are backed by a no-touch warranty covering all parts, labor, and routine maintenance.

8. How can I make sure I get the results I want?

Sports lighting is a big investment that can bring a wide range of benefits to your community for years to come. There are some important steps you can take to ensure you get the results you want.

Define Standards

Make sure to get written specifications that establish the performance you expect. Remember to incorporate the lighting, structural, and electrical components and the costs involved for design, supply, installation, and operation (see page 6) into your planning. Specify the values you want for playability, environmental light control, life-cycle cost savings, and warranty.

Clearly defined standards will help you avoid two problems on bid date:

- Insufficient, cheap equipment substitutions to lower bid price
- High bids to cover the uncertain costs of an underdefined project

Seek Accountability

Having a manufacturer that stands behind its product and provides good service will make a huge difference in long-term satisfaction with your lighting system.

Require Written Guarantees — Manufacturers can provide written performance guarantees for light levels and your entire system from the foundation to the fixtures. This will ensure the specifications you establish are met. Getting this guarantee from a single-source system provider will save you the headache of sorting out responsibility among multiple manufacturers should a problem arise.

Compare Warranties and Services — It's essential to understand and compare different manufacturer warranties. The warranty reflects a manufacturer's confidence in how its lighting will perform. Some manufacturers provide single-source accountability, offering a long-term warranty covering all parts and onsite labor. Other manufacturers' lighting includes several warranties from a variety of suppliers whose parts and pieces are included, which can lead to confusion as to what's covered, for how long, and by whom. Some manufacturers include services such as on/off controls and proactive system monitoring.

RETROFITS

All LED sports lighting is not created equal, so if you're considering an LED retrofit it's important to visit other facilities similar to yours that have recently completed retrofit installations to see how different manufacturers' lighting performs.

Get References — Ask for references and review each manufacturer's reputation and track record for service. A good question to ask is if there will be an on-site field performance evaluation after the installation, as well as how far away the manufacturer's service technicians are. This will impact how long it takes to address problems that may arise.

See For Yourself — There's no better way to compare and contrast the performance of different manufacturers' lighting than by getting out onto fields and seeing it firsthand. Ask to visit nearby facilities that are similar to yours, and talk with the owners about their overall experience and how well the manufacturer did at helping them achieve their lighting goals.

"The bitterness of poor quality remains long after the sweetness of low price is forgotten."

— Benjamin Franklin

Musco's long-term warranty and performance guarantee covers every part and all labor, and is backed by a service Team of more than 170 professionals including regionally-based technicians, 24/7 proactive monitoring, instant on/off controls, and the support of a fully-staffed call center.

9. Is there funding help available?

Funding is often the most critical and challenging aspect of a sports lighting project. It's important to know there are options available that can bring your project within financial reach.

Utility Grants & Rebates

Many utility companies offer incentives to promote the use of energy-efficient products, including sports lighting. Incentives vary and come in the form of rebates, grants, low-interest loans, and/or reduced kilowatt rates. Once the utility company completes an energy-savings audit, it can help fund new lights or upgrade your existing equipment with an energy-efficient system. Make sure that the replacement system meets the light level, light control, warranty, and other specifications.

Manufacturer Financing

Well-established manufacturers may offer financing programs for municipalities, public schools, and other organizations to provide a "budget stretcher" to help with facility improvements. The added revenue from expanded use of your facility can help make the annual payments and allow you to enjoy the benefits of your lighted facility sooner. Plus, a set payment can be built into your annual budget, freeing you from budget uncertainties and cash flow implications of a large purchase.

Unique Fundraising

Look for fundraising campaigns and programs that may be out there in conjunction with manufacturers and organizations, such as Little League® and Babe Ruth®. Check with local businesses to gauge their interest in purchasing advertising at your field as a way to raise funds for lighting.

Volunteer Installation

Well-designed sports lighting systems can offer a simplified and streamlined installation, in which case you can recruit volunteers to assist with the process. This is a good way to save money and reduce your overall costs.

RETROFITS

If you are working with an Energy Service Company, or ESCO, be sure to take into account important aspects such as on-field light levels, spill and glare control, and warranty to ensure your retrofit project doesn't sacrifice quality.

Musco offers financing options and a resource database to identify grants and incentives available to make your project happen. Musco also partners with organizations such as Little League®, Babe Ruth®, and U.S. Soccer Foundation to award field lighting systems at a discount. Musco's unique Pennant Program™ fundraising provides advertising opportunities using pennants displayed on light poles to help with both initial and annual operating costs.

Lighting terms you'll hear

Creating Light Energy

Light-emitting diode (LED): Small semiconductor device that creates light when electricity passes through it.

High intensity discharge (HID) lamp: Metal halide, high-pressure sodium, and mercury vapor — a group of light sources that create light when electricity ignites gases inside an arc tube.

Incandescent: A light source that creates light when electricity passes through a filament.

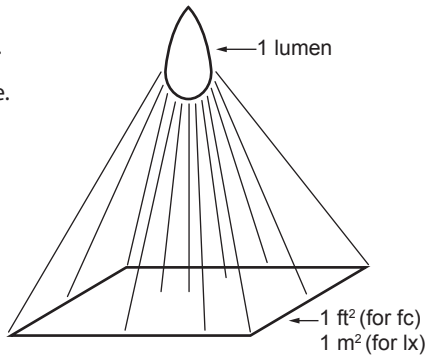
Measuring Light Energy

Lumen (1 lm): Measure of light, much like a liter is a measure of volume.

Footcandle (fc): One lumen of light spread over 1 square-foot of surface. A light level of 30 footcandles means that 30 lumens of light are being projected onto each square foot of playing surface.

Lux (lx): Lux is the metric equivalent to a footcandle. A lux is 1 lumen spread over 1 square meter.

Candela (cd): Measure of the intensity of a light source. Relates to predicting on-field and off-field glare. You can relate this to car headlights: high beam = approximately 30,000 cd, low beam = approximately 12,000 cd.



Coloring rendering index (CRI): A scale from 0 – 100 used to measure a light source's ability to show colors realistically as compared to natural light (daylight). Higher CRI values mean a light source is more true to color.

Color temperature: A unit of measure in degrees Kelvin that indicates the color of a light source. Temperatures below 3500K appear yellow or warmer. Above 4500K appear bluish white or cooler. Absolute white is 5000K.

Controlling Light — Lighting Performance

Photometrics: Control of light energy through redirection.

Constant light level: The amount of light you can expect on the field at any given time over the extended life of the fixture or system.

Initial footcandles or lux: The amount of light on the field when the lighting system is first put into use.

Target (maintained) footcandles or lux: The lowest average amount of light you should always have on your field to meet minimum performance requirements.

Light loss: Amount of brightness from a fixture lost over time due to aging of the light source, dirt accumulation, temperature and voltage variations, and maintenance.

Lumen maintenance (Lp): The number of operating hours an LED light source will maintain the percentage (p) of its initial light output, noted as Lp.

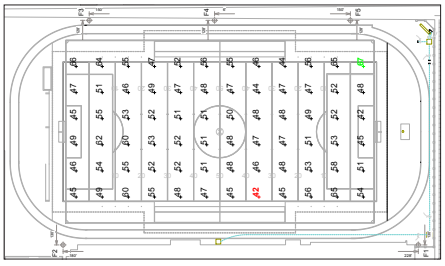
Uniformity: The smoothness of light on the field.

Point by point scan: Computer-generated model of your proposed lighting system showing footcandle/lux readings at given points on your field.

Spill light: Wasted light that falls off the field into undesired areas, such as a neighbor's back yard.

Glare: Destructive light from a light source that shines in players', spectators', or neighbors' eyes, making it difficult to see.

Sky glow: Destructive light in the night sky which results from light that is reflected upwards.



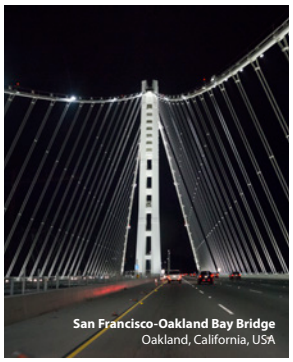
Point by point scan

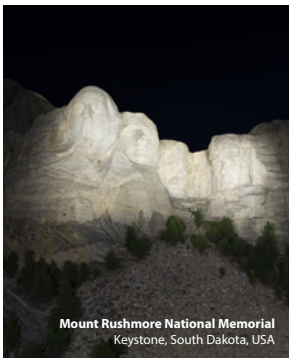
We will help get you started

From our expert project managers to our team of certified engineers, we will work with you to design a custom foundation-to-poletop or retrofit lighting solution that:

- Reduces your facility's energy and life-cycle costs
- Delivers superior controlled light guaranteed to meet specified light levels
- Controls spill light, glare, and sky glow
- Eliminates maintenance costs
- Simplifies operation and reduces cost with our Control-Link® system monitoring, management tools, and on/off control.

Lighting solutions for your large area applications


San Francisco-Oakland Bay Bridge
Oakland, California, USA


Mount Rushmore National Memorial
Keystone, South Dakota, USA


Smokey Row Coffee Company Parking Lot
Des Moines, Iowa, USA

Need to light a non-sports project?

Musco's team of expert engineers create innovative lighting solutions for a variety of applications from small parking lots to large ports and national monuments. Since 1976, Musco has established itself as the global leader in sports and large area lighting solutions. For innovative lighting systems that enhance light quality, improve effectiveness, reduce spill light and glare, cut costs, and minimize the impact on our environment, contact Musco.

- Parking lots
- Buildings and architecture
- Monuments
- Ports, airports, and rail yards
- Construction sites
- Bridges and roadways
- Security
- And much more

For **FREE** planning assistance for your sports-lighting project contact:

We Make It Happen®

www.musco.com

lighting@musco.com

Phone: 641.673.0411

Toll-free: 800.825.6030

Connect with us:

ATTACHMENT C

Qualifications of Preparers

EcolSciences, Inc.

Environmental Management & Regulatory Compliance

LAURA NEWGARD, PWS

EDUCATION:	*M.S., 1984 - Wildlife and Fisheries Sciences* *Texas A & M University* *B.S., 1982 - Forestry/Wildlife Management* *Purdue University*
AREAS OF EXPERTISE:	*Wildlife Ecology* *Wetlands and Terrestrial Ecology* *Rare Species Surveys and Construction Monitoring* *Environmental Impact Assessment and Mitigation Planning*
PROFESSIONAL CERTIFICATIONS:	*Certified Wildlife Biologist (CWB)* *Professional Wetland Scientist (PWS)* *Recognized Qualified Bog Turtle Surveyor; New York, Pennsylvania and New Jersey (USFWS) Phase 1, 2, and 3 (trapping)* *Recognized Qualified Indiana/Northern long-eared Bat Surveyor (USFWS)* *NJDEP qualified Venomous Snake Monitor (Tertiary)* *NJDEP qualified Wood Turtle Monitor* *Threatened and Endangered Species in New Jersey: Regulations, Identification and Assessment - Rutgers University* *BCI Bat Conservation and Management Workshop* *Interagency Coordination for Endangered Species (USFWS)* *Federal Manual for Identifying and Delineating Wetlands*
OTHER:	*Northeast Partnership in Reptile and Amphibian Conservation (NEPARC)* *Northeast Bat Working Group (NEBWG)* *USFWS Adopt-a-Swamp Pink Population Volunteer* *NJDEP Bog Turtle Survey and Trapping Volunteer* *NJ Venomous Snake Response Team (NJDEP) Volunteer* *PA Chapter of the Nature Conservancy Bog Turtle Volunteer*

EXPERIENCE:

Ms. Newgard is a Certified Wildlife Biologist and Vice President with EcolSciences, Inc. Her expertise lies in the identification and evaluation of land for the presence/absence of rare wildlife and plant resources, including habitat assessments and species-specific surveys; and providing guidance on the preservation and protection of these terrestrial, wetland, and aquatic ecosystem through environmental planning and construction monitoring.

Ms. Newgard's responsibilities include: wildlife and plant surveys; threatened and endangered

species studies; delineating wetland systems based on the Federal "three-parameter" methodology; the preparation of wetland and habitat mitigation plans to compensate for unavoidable disturbances to natural systems; and preparation of environmental impact assessments. Ms. Newgard has conducted threatened and endangered species surveys at the request of the United State Environmental Protection Agency (USEPA), New Jersey Department of Environmental Protection (NJDEP), United States Fish and Wildlife Service (USFWS), National Park Service (NPS), New York State Department of Environmental Conservation (NYSDEC), and New York City Department of Environmental Protection (NYSDEP). In addition, Ms. Newgard has been involved with permit acquisition including Individual and Nationwide Permits from the Army Corp of Engineers and wetland permits from NJDEP and NYSDEC.

A summary of relevant project experience accumulated over the last several years includes:

- Design, manage, and conduct wildlife habitat studies and threatened and endangered species surveys for numerous wildlife species, including; bog turtle, Indiana bat, northern long-eared bat, grasshopper sparrow, short-ear owl, long-ear owl, wood turtle, long-tailed salamander, blue-spotted salamander, pine snake, pine barren's tree frog, southern gray tree frog, northern cricket frog, timber rattlesnakes, Northern copperhead, red-shouldered hawk, barred owl, Coopers hawk, goshawk, bobcat, and bald eagle. These studies provided comprehensive wildlife lists inhabiting a site, identified extent and potential habitat communities, and identified or confirmed the absence of rare species and their suitable habitat on 100s of sites throughout New York and New Jersey. Select studies include acoustic and mist nets surveys for Indiana and northern long-eared bats; telemetry surveys for wood turtles, bog turtles, and pine snakes; trapping for bog turtle and northern pine snake; vernal habitat surveys, migration studies, design, enhancement, restoration; and drift fences and pitfall traps for reptiles and amphibians.

Specific Government related projects include:

- Watergate Wetlands Restoration Project in the Delaware Watergap National Recreation Area (DEWA): Project manager for all wood turtle telemetry studies, pre -and post construction, and monitoring for wood turtles, timber rattlesnakes, and other wildlife species during construction.
- Picatinny Arsenal: Ongoing wildlife studies including acoustic and mist netting surveys for Indiana, northern long-eared, tricolored, and small-footed bats; wood rat camera surveys and food plot surveys, bog turtle Phase 1 surveys, wood turtle rapid assessment surveys.
- Bog turtle telemetry and trapping in DEWA: Conducted one year trapping project in historic bog turtle habitat in Pennsylvania. Conducted two-year presence/absence surveys and telemetry on bog turtle population in New Jersey.
- Wetland Delineations in DEWA. Conducted wetland delineations and NJDEP permit applications for proposed sewer line project in DEWA.

Selected sites include:

- ***500-acre recreation amusement park development****:* Threatened and endangered species wildlife habitat assessment, Northern cricket frog survey, Phase 1 bog turtle surveys, Indiana and Northern long-eared bat acoustic surveys, USFWS Biologic Assessment (BA)

Orange County, New York.

- ***Multiple Community Solar Projects:*** Threatened and endangered species habitat assessments and surveys, including wintering raptors, bog turtle Phase 1, Indiana and Northern long-eared bat acoustic surveys. Orange County, New York.
- ***250-mile utility alignment:*** Phase 1 and Phase 2 bog turtle surveys. York, Adams, and Franklin Counties, Pennsylvania.
- ***44-mile above-ground utility alignment:*** Phase 1 and Phase 2 bog turtle surveys, Wood turtle surveys, timber rattlesnake den, basking, and gestation surveys, vernal habitat surveys, Indiana bat mist net surveys, timber rattlesnake, northern copperhead, and wood turtle construction monitoring, vernal habitat restoration and creation plans. Morris and Sussex Counties, New Jersey.
- ***20-mile above ground utility alignment:*** Phase 1 and Phase 2 bog turtle surveys, Indiana bat mist summer mist net surveys, bog turtle habitat restoration, construction monitoring, radio telemetry surveys for bog turtle and Indiana/Northern long-eared bats, blue-spotted salamander surveys. Morris County, New Jersey.
- ***16 – mile and 8 – mile pipeline easements:*** Phase 1 and Phase 2 bog turtle surveys, wood turtle surveys, wood turtle hibernacula surveys, wood turtle, bog turtle, and timber rattlesnake construction monitoring. Sussex and Passaic Counties, New Jersey.
- ***2,000-acre mixed use development site:*** Timber rattlesnake and copperhead den surveys, Indiana bat mist net/acoustic surveys, vernal habitat surveys, marbled salamander pitfall trap migration surveys. Rockland and Orange Counties, New York.
- ***3,200-acre mixed use development site:*** Phase 1 and Phase 2 bog turtle surveys, small whorled Pogonia Surveys. Tobyhanna and Monroe Counties, Pennsylvania.
- **200-*acre redevelopment site*** (bog turtle Phase 1 surveys, timber rattlesnake habitat assessment/den emergent surveys, cricket frog survey). Sterling Forest, New York.
- **6-mile and 8-mile pipeline project** (Indiana bat/Northern Long eared bat habitat assessment). Somerset, Mercer, and Hunterdon Counties, New Jersey.

- Design, manage, and conduct vegetative inventories and threatened and endangered species surveys for several plant species, including; swamp pink, Kneiskern's beaked-rush, curly-grass fern, small whorled pogonia, spreading globeflower, little lady tresses, climbing fern, and serpentine aster. These studies also served to confirm the absence of these species and their suitable habitat on certain sites.

- Wetland delineation and impact assessment for numerous commercial and residential development projects throughout New Jersey, New York and Pennsylvania. Reports analyzed site conditions, classified wetlands and were prepared for submission to the appropriate agency.

- Conduct, manage, and implement Habitat Suitability determination studies and develop Habitat Impact Assessments and/or Habitat Enhancement Plans.

- Preparation of wetland creation/mitigation reports for commercial and residential projects in which unavoidable disturbances will occur to existing wetland communities.