ETHICALLY SOURCING THE GROUND

INVESTIGATING FORCED LABOR IN LANDSCAPE ARCHITECTURE MATERIAL SUPPLY CHAINS

FINAL REPORT

January 29, 2026

MNLA /TRUBIANO. F

ETHICALLY SOURCING THE GROUND

INVESTIGATING FORCED LABOR IN LANDSCAPE ARCHITECTURE MATERIAL SUPPLY CHAINS

FINAL REPORT

January 29, 2026

MNLA /TRUBIANO. F

ETHICALLY SOURCING THE GROUND: INVESTIGATING FORCED LABOR IN LANDSCAPE ARCHITECTURE MATERIAL SUPPLY CHAINS

Published by MNLA/Franca Trubiano

Text and Graphics by
Franca Trubiano, University of Pennsylvania
Ivanna Dudych, University of Pennsylvania
Amy Arato, MNLA
Noriko Maeda, MNLA
Signe Nielsen, MNLA
Jeb Polstein, MNLA
Emily Silber, MNLA
Lee Williams, MNLA

MNLA Weitzman School of Design University of Pennsylvania

Publication date: January 2026

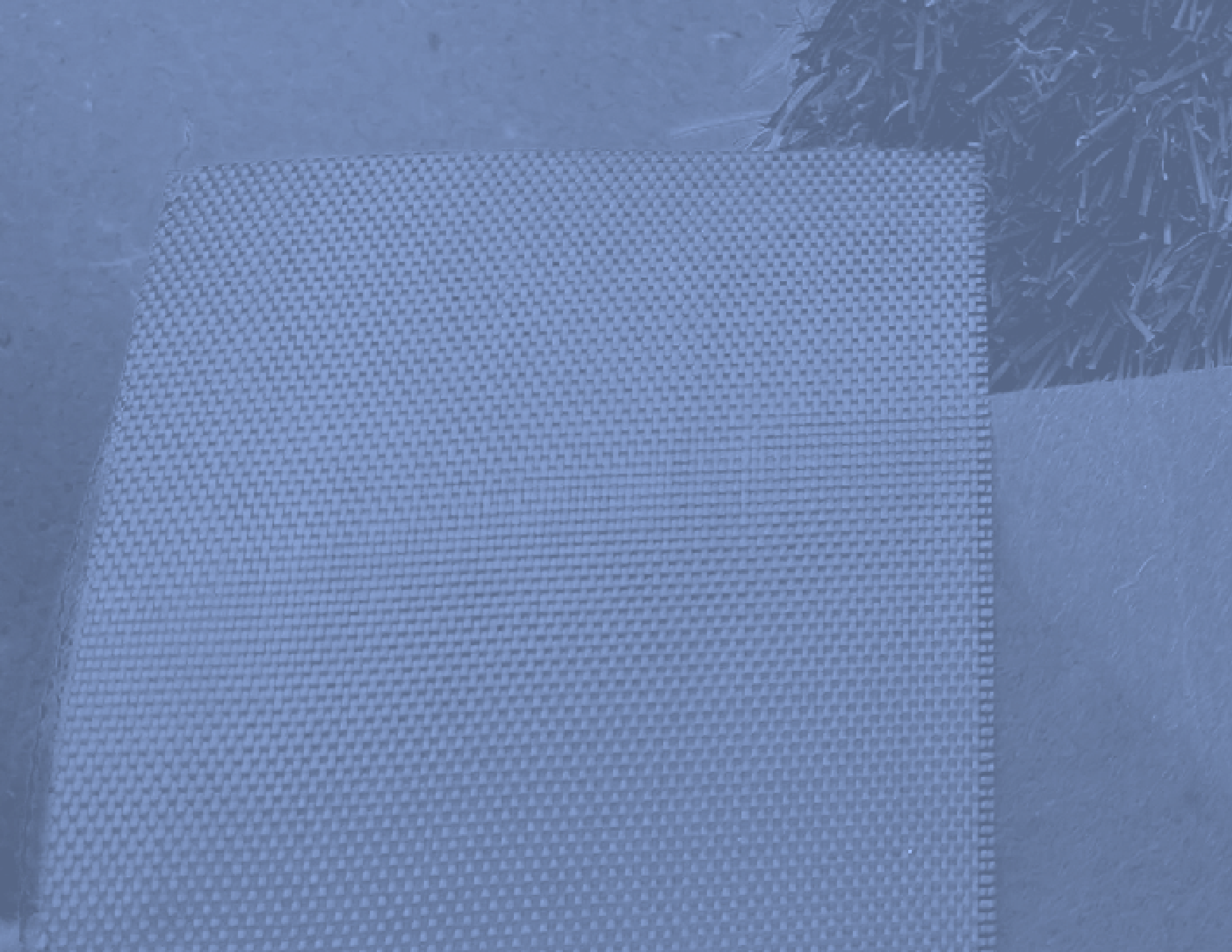
ACKNOWLEDGMENTS

This research was made possible with funding from the 2024 Deb Mitchell Research Grant, awarded by the Landscape Architecture Foundation (LAF). The research team wishes to express its profound gratitude to Megan Barnes who as Senior Project Manager guided and facilitated our work for well over a year. We also thank LAF Board Members and Emerita, Heather Whitlow, Eric Gilbey, Jenn Engelke, Meg Calkins, and M. Elen Deming for their inputs.

We recognize the contributions of Sharon Prince and Brigid Abraham, from Design for Freedom at Grace Farms; Catherine De Almeida from the University of Washington; Susie Teal, Partner at COOKFOX Architects; and Barbra BatShalom, CEO and Founder of BuildingEase. We are thankful for Ruby Wei's participation, who as Professional Engineer for the City of New York helped us navigate procurement questions important to large city governments. We thank Amy Syverson-Shaffer, from Landscapeforms and Nate Heydt, from Loll Design who agreed to discuss purchasing cultures at their respective companies. Professor Sarah Billington shared her research on material sourcing at Stanford University. Professor Shawn Bhimani and researchers Katie Shaw and Tommie Lynn from Supply Trace offered important insights, while Professor Laura Murphy and researchers Jim Valette and Caroline Dale contributed important research on forced labor in the supply chain of polymers. We are grateful to those material suppliers who completed our Questionnaire and to the landscape architects who completed our Survey.

Finally, this research project would not have been possible without the collaborative involvement of Sayari and their representatives, Phil Kittock, Grace Chen, and Debora Almeida. They eagerly welcomed our research questions, and it was our ability to cooperate with them that contributed key data to this project. We remain grateful for Sayari's willingness to share their platform with us.

TABLE OF CONTENTS



1.0
Planning the Project

1.1 EXECUTIVE SUMMARY

1.1.1 Project statement and goals

As designers of the built environment, landscape architects play a powerful role in shaping space through a variety of means, one of which is materiality. Yet, as designers, we rarely question the nature of materials beyond aesthetics and performance. In response, this research project asked: How can landscape architects and researchers think of materials as processes embedded with labor? How can our work have a positive, catalytic impact on advancing fair labor practices through investigative approaches to data collection and corporate responsibility, by recommending appropriate certifications, by writing project specifications, and by evaluating the forced labor risk of material suppliers? Building upon the foundation set forth by our peers, this research focused on how best to assess the risk of forced labor associated with commonly specified, widely used products prevalent in landscape architecture, including permeable pavers, geotextiles, synthetic turf, rubber safety surface, and recycled plastic lumber.

An estimated 28 million people worldwide are ensnared in forced labor today, with the architecture, engineering, and construction (AEC) industry being among the most impacted and at risk.[1] While the United States Customs and Border Protection bans products made with forced labor, the lack of supply chain transparency and the disaggregated nature of the building material industry allow for products made with forced labor to inadvertently infiltrate the US market.[2] According to the 'Walk Free' Organization, the US can potentially import close to 170 billion dollars of products at risk of forced labor.[3] This is more than three times the risk carried by Japan, the second-largest G20 importer of products linked to forced labor, with Japan at risk of importing as much as 53 billion dollars.[4] Common products at risk of being produced with forced labor include electronics, solar panels, textiles, and timber, a good deal of which are destined for the building industry.[5] Faced with such staggering numbers, what are the currently available tools, protocols, and data resources of use to the industry for exposing its risk to forced labor? In what way can more conscientious sourcing and procurement practices of our construction materials become a crucial part of the construction industry's solution for addressing this important question of social equity?

1.1.2 Project Conclusions

Three key conclusions can be drawn from this research project:

1. **The industry lacks transparency in what concerns the material supply chains of all building products used to construct the built environment.**
    a. Manufacturers are unaware of the forced labor risks in their supply chains. In a culture of capital flows predicated on "don't ask, don't tell":
        i. Company representatives who serve designers are unaware of the problem of forced labor and of what their companies are doing in this regard.
        ii. Company representatives are minimally more aware of their company's sustainability position, but without access to hard evidence to prove their claims.
        iii. Company representatives were ineffective at connecting us with company representatives who might know more about material supply chains.
    b. Designers are mostly unaware of the extent and scale of forced labor in the material supply chains of the products they specify.
    c. Researchers affiliated with the building industry are insufficiently focused on the supply chain of materials used in constructing the built environment. The lack of sustained academic activity amongst landscape architects and architects in this space is clear evidence of the fact that few question the origin of materials with which we build.

2. **Industry-based Certifications are presently insufficiently robust to ensure that forced labor is not found in the supply chain of our material products.** None of the certifications we reviewed convincingly certifies products in the construction industry against the presence of forced labor.

3. **Greater transparency in material supply chains is required, with access to third-party, objective data essential for investigating and evaluating the forced labor risk of any one company in the building industry.** Corporate advertising and marketing are insufficient and, at times, misleading indicators of a company's forced labor risk.
    a. Using the Sayari Graph interface, we produced an Evaluated Risk Assessment Scale for assessing the forced labor risk of the 34 companies we investigated.
    b. Summary of the Evaluated Risk Assessments for the 34 companies investigated.
        - 10 companies had Clear Evidence of Forced Labor Risk
        - 8 companies had First Tier Forced Labor Risk*

- 5 companies had Second Tier Forced Labor Risk
- 2 companies had Third Tier Forced Labor Risk
- 1 company had Possibly No Forced Labor Risk
- 0 companies had No Forced Labor Risk
- 10 companies had Insufficient Information in Sayari to Evaluate

*Tiers are moments in the supply chain where a company transfers a material component to another.

1.1.3 Project Recommendations

The following outlines the most basic tenets of a culture of informed practice dedicated to minimizing, if not eliminating, the risk of forced labor in the supply chain of landscape architecture products.

1. Laws exist – use them!
International, national, state-, and city-wide laws exist in support of workers, their rights, livelihood, and health. This report identifies and discusses several laws that are effective for reducing the incidence of imported material products made with forced labor. Notwithstanding the difficulty in enforcing these laws, knowing that they exist, and communicating that they do to clients, public officials, contractors, and materials representatives is a clear path to more informed decision-making.

2. Lobby to be heard, act to instill real change.
The scale of the problem cannot be denied. Is this because few design professionals speak to the incidence of forced labor with their colleagues, clients, public officials, and material suppliers? Should we more actively share this information as widely and repeatedly as possible? Should design students be taught about the toil of those who labor on their behalf when building their designs? Should material manufacturers and everyone who supplies raw materials be held to greater levels of transparency in disclosing how their products are manufactured? Should they be required to communicate which materials they've used, where they originate from, and if and how they imperil others at any point in their supply chain? Should we be ethically held to sharing with the public questionable corporate practices that transgress human-centered values, including the use of forced labor? Should we lobby for greater legislative leverage to ensure that no building or landscape project renders someone precarious? YES!

3. Align project teams to the values of forced labor-free supply chains
Every new project is another opportunity to expand the network of professionals and clients committed to ensuring that forced labor is not present in the building industry. Speak openly and committedly about aligning all stakeholders to this shared mission. Articulate clear goals that are measurable, verifiable, and communicable. Ensure benchmarks, contract documents, and specifications establish the goals, mechanisms, penalties, and redress for ensuring that all who are signatories to the contract are held responsible for ensuring that no forced labor is identifiable in the supply chain of all materials and services associated with the project.

4. Identify which raw materials are at most risk of forced labor.
Every raw material in the building industry is at risk of being produced using forced labor. These include sand, the most pedestrian of materials that many do not recognize as a building material, and polyethylene, a chemically synthesized material that begins its life in a lab. Using the sources offered in this report, identify which are the most critical for your landscape design project. Assess the ratio of the risk and ask for modifications and changes as required.

5. Identify supply chains of material products and their companies at most risk of forced labor.
Large sectors of the global supply chain of building material products are at risk of being produced using forced labor. These include the most typically specified, such as concrete, and the most rarefied, such as rubber gaskets for double skin facades. Given the material complexity of most high-performing products that are engineered for specialized activities, and the composite nature of many of our materials, following the supply chain of most building products is a highly complex endeavor. In every project you work on, identify (5) material products you believe are at high risk, and (5) material products that comprise the greatest part of the project budget. Focus on their overlap and ensure the team has the correct investigative mechanisms to identify whether the material products specified for your project are at risk for forced labor.

6. Require proven fair labor certifications and associated language in contract specifications.
Encourage certifications that are rigorous, data based, and whose evidence is verifiable. Encourage language in contract documents focused on forced labor, including penalties should materials be found with forced labor, including the right of refusal and of payment for said material. Designers should directly engage their suppliers on questions of supply chains and their fair labor certifications to increase demand for the resources of help to manufacturers

who wish to obtain fair labor certifications. When including the requirement for fair labor certifications in specifications, it is important to have an agreement in place from as early in the project design and documentation phases as possible.

7. Investigate and ask questions.
Much of the information you seek is not immediately available. This became clearly apparent to us during this research project. The building industry lacks transparency in its material supply chains for most products used to construct the built environment, partly due to a lack of interest, corporate competition, and patenting of products. Both company representatives and designers are largely unaware of the extent of the problem and how best to secure accurate data for decision-making. Corporate-issued advertising and marketing are insufficient forms of information gathering. Sustainability statements are often too general to be verifiable, ESG claims are not metrically certifiable, and EPDs and HPDs are nonexistent. Moreover, it is not surprising that many claims made by for-profit enterprises are at times misleading.

What is needed is access to third-party, objective data for investigating and evaluating the forced labor risk of any one company in the building industry. And this, because the typical business protocols available to designers rarely reveal the required information to investigate what is in a product, how it is sourced, and whether it was produced in questionable human circumstances. In fact, much in the day-to-day business of construction (landscape and building) is designed to obfuscate precisely the information we seek on corporate governance. Investigative tactics are a prerequisite for entering into less-than-transparent territories where harms against laborers proliferate. Look deeply, ask many questions!

1.1.4 Defining the Problem: Forced Labor in the Built Environment

In 2007, *The New York Times* published an article that shed light on the unregulated working conditions of a metal forging workshop in Haora, India, where workers poured metal castings that would ultimately serve as New York City's Department of Transportation (DOT) manhole covers.[6] The article included images of men working in minimal clothing, barefoot, and shirtless, pouring molten metal at more than 2,500 degrees Fahrenheit into molds on the floor near their feet. Possibly, New York City construction budgets benefit from the cheap labor of those who are forced to work under conditions that are not legal in the U.S. This news story, albeit shocking, did not motivate a change of practice, policy, or law in the City. And if these are the conditions under which products purchased by NYC are manufactured today, NYC citizens are no less the wiser.

Indeed, supply chain transparency in the construction industry is not a topic pursued by the industry or the public for a variety of reasons. It serves everyone who profits from the chain of production to keep this type of information in the shadows. To know that individuals are being harmed in the process of constructing the built environment is information that few are interested in communicating. After all, it is illegal and a crime to profit from the forced labor of others. As defined by the "US Trafficking in Persons Report" from 2024, "forced labor"—also sometimes referred to as labor trafficking—involves one person's use of force, fraud, or coercion to exploit the labor or services of another person.[7] The "means" of force can include threats of violence, debt manipulation, withholding of pay, confiscation of identity documents, psychological coercion, reputational harm, manipulation of the use of addictive substances, threats to other people, or other means of coercion.[8] The term "forced child labor" describes circumstances when traffickers compel children to work, the sale of children, forced or compulsory child labor, debt bondage, and serfdom of children exist in the world today.[9]

At this time, federal laws in the United States forbid slavery and forced labor within its borders and the importation of goods manufactured by means of forced labor from abroad. The 13th Amendment abolishing slavery was passed in 1865. Sixty-five years later, section 307 of the Smoot-Hawley Tariff Act of the 1930s prohibited the US from importing any goods or materials manufactured in whole or in part with forced labor. This law did not ultimately ensure, however, that products made using forced labor did not enter the country, since products that were in short supply were exempt from the law.[10] The Trade Facilitation and Trade Enforcement Act of 2015 (TFTEA) further prohibited the importation of anything manufactured with forced labor at US borders, with Forced Labor being one of the Act's main areas of focus.[11] To further strengthen the laws around forced labor, the Uyghur Forced Labor Prevention Act of 2021, enacted in 2022, prohibits anything manufactured from the Xinjiang Uyghur Autonomous Region (XUAR) of China from entering the US.[12] However, even with this legislation in place, it is highly probable that the disaggregated nature of our building industry allows materials created with forced labor to enter the country.

Landscape architects practicing in the US may be unaware that US laws against forced labor could impact which construction products enter the US and which are used on job sites and building projects. They may also be unaware of the large

role that plastics play in the fabrication of softscape and hardscape assemblies, and how much obscurity in the supply chain of the plastic industry enables the distribution of cheap plastics that exploit the health and labor of others.

This report sheds light on this issue by making it harder for designers and all involved in building landscapes in the US to remain unaware of important facts governing our projects. We operate in a complex supply web that, unfortunately, enables forced labor, profits from it, encourages its obfuscation, and silences those who question the industry's supply chains. While the fashion and food industries are more fully aware of forced labor within their supply chains—because brand names are more publicly visible on our clothes and packaging—companies manufacturing building products are often not household names and therefore harder to hold publicly accountable.

This report outlines a research process used to discover which commonly used landscape architectural materials are at risk of having forced labor in their supply chains. This report also offers a guide to those in our profession and surrounding fields of practice who wish to become better informed on the subject and who seek best practices and actions in support of greater transparency. And while our research began with a focus on companies whose manufactured goods are purchased by NYC Parks, many additional companies became the subject of this case study. The information in this report serves landscape architects, contractors, clients, and city agencies who seek greater knowledge about where their materials come from.

Communicating our Data:
All evidence derived from the questionnaires and SAYARI interface are shared within this report. The nature of the research and its findings preclude our ability to disclose the names of the 34 companies that were analyzed for supply chain transparency.

1.2 PROJECT TEAM

1.2.1 Research Team

Principal Academic Investigator:
Franca Trubiano, PhD.
Associate Professor, Architecture
Graduate Group (PhD) Chair in Architecture
Stuart Weitzman School of Design
University of Pennsylvania

Academic Research Team:
Ivanna Dudych, Research Assistant, University of Pennsylvania

Principal Landscape Practice Investigator:
Noriko Maeda, RLA, ASLA
Senior Associate
Mathews Nielsen Landscape Architects, P.C. (MNLA)

Landscape Architecture Research Team:
Signe Nielsen, Founding Principal of MNLA
Amy Arato, Senior Landscape Architect
Jeb Polstein, Senior Landscape Designer
Emily Silber, Landscape Architect
Lee Williams, Landscape Architect

1.2.2 Consultants and Advisers

Sharon Prince, CEO and Founder of Grace Farms
Catherine De Almeida, Associate Professor of Landscape Architecture of the College of Built Environments, University of Washington
Susie Teal, Partner, COOKFOX Architects
Barbra BatShalom, CEO and Founder of BuildingEase

1.2.3 NYC Parks Collaboration

With such large purchasing capital, the New York City Department of Parks and Recreation (NYC Parks) has a great deal of influence on the market of landscape construction materials. NYC Parks manages 30,000 acres of land, which is 14% of New York City. This includes 800 athletic fields and nearly

1,000 playgrounds.[13] The six landscape practitioners on our research team from MNLA have extensive knowledge of the NYC Parks' workflow and preferred materials. To this, we set out to add information on the scope and scale of NYC Parks' yearly operations and specifications. We analyzed the quantity and bid amount of landscape materials contracted by the agency by launching a Freedom of Information Law (FOIL) request. We studied published specifications for materials purchased on their behalf by requesting all pertinent material specifications.

1.2.4 Sayari Participation

Starting in July 2024, we began a working relationship with an online company that collates open-source data related to supply chain mapping. In setting up this research-based relationship, Professor Trubiano contacted the company many times to identify individuals with whom they could establish a no-cost, In-Kind contract for access to their website and database. By October 2024, we were given access to the Sayari Graph portal, which allowed us to investigate the potential risk of forced labor within the supply chains of the companies we identified. Access was made possible by Phil Kittock, Lead Analytical Content Manager, and Debora Almeida, Senior Content Manager from Sayari.

This project and its outcomes acknowledge the support of Sayari. Without our ability to review the information and data that this company collates, it would've been impossible for us to evaluate the forced labor risk of any of the landscape architecture material products we studied. We are very grateful.

1.3 PROJECT TIMELINE

1.3.1 Phase Reports

Phase 1

During the first four months, from July through October 2024, our joint team of academics and landscape architects laid the foundation work for our report. This report set the context for our research within a field of published works, described our full team and collaborators and explained our multipronged research methodology. As a result of our efforts to collect data in various ways, we began evaluating our findings at an initial level and reassessed the ways in which our practices could be finetuned in the next two phases.

Noriko Maeda's Professional Practice Team at MNLA met weekly with Primary Research Partner Franca Trubiano to complete the first phase in developing this body of work. This report established how we began to identify and engage manufacturers. It also discussed other tools to trace connections between companies and the raw material resources used to fabricate the five material products selected. MNLA selected 5 material products as the basis for our research: rubber safety surface, permeable pavers, geotextiles, synthetic turf, and recycled plastic lumber. As part of phase one, we strove to assess the scale of use of these materials within the built environment of NYC's public realm by collecting data from projects that the Parks Department has commissioned in recent years.

During Phase 1 we met with experts to assess the most effective questions for our Manufacturer's Questionnaire and Landscape Architect's Survey. We assessed potential connections with the Design for Freedom movement, by reviewing their documentation and that of DFF collaborators. We also advantageously utilized the platforms of the American Society of Landscape Architecture, the Design for Freedom Movement, resources at the University of Pennsylvania as well as within MNLA to develop the best research and outreach methods to complete our research.

Phase 2

From November 2024 through April 2025, our joint team of academics and landscape architects progressed our research of the landscape building materials used commonly in New York City and specifically on public work. This report outlined how we engaged manufacturers directly as well as examined them indirectly, drew information from the local and national landscape architecture community, and made connections to the NYC Parks Department. As our Phase 2 report showed, our team pursued different means of directly engaging the 25+ manufacturers referred to in our study. It shared the results of our Manufacturer's Questionnaire that was outlined in Phase 1, identified our repeated outreach, and conveyed the scope of the information we sought to collect from them. This information included all available EPDs and certifications a company may have access to for attesting to the materials and labor involved in the fabrication of their product. Our direct and indirect approaches when viewed together, suggest a compelling narrative of where there may be risks involved in the fabrication of our landscape material products.

During Phase 2, a substantial number of investigations were undertaken using the Sayari database. Here, we evaluated the forced labor risk of our chosen companies. The use of Sayari Graph was essential to help visualize the interconnected relationship between multiple tiers of a company's supply chain. It was also essential to map trade routes and risk factors. All material categories were investigated, and initial diagrams and global maps were produced for a dozen companies.

Lastly, during Phase 2, three presentations about forced labor in material supply chains were made to Penn State, Montana State University, and Dartmouth College, by Franca Trubiano.

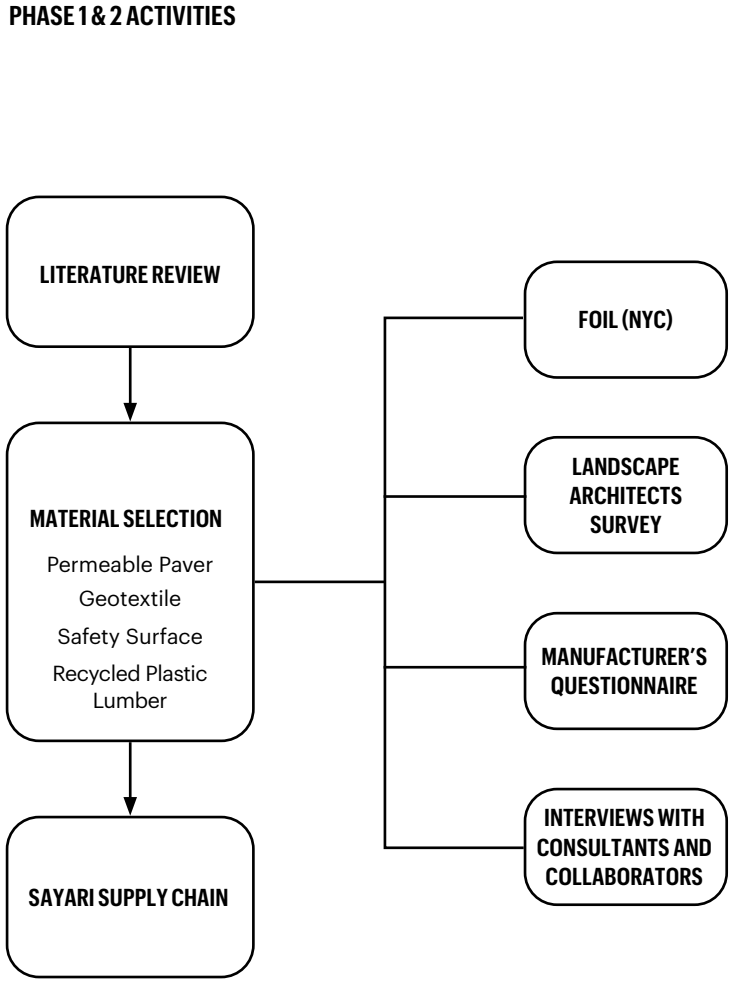


Figure 1.01, Phase 1 and Phase 2 Activities

Phase 3

In our final phase, from April - October, our team finalized our study's engagement with manufacturers and created our final assessment of the responses to the Questionnaire. We met with our consultant Barbra Batshalom, CEO of BuildingEase who helped characterize her assessment of the construction industry priorities and state of transparency within its own organizations. In addition, we met with Professor Sarah Billington, Stanford University, and her team to discuss possible research methods for identifying the source of raw materials in concrete. We also met with Grace Farms to assess the current availability of certifications within the plastics industry.

Most critically, our team extracted, organized and documented the forced labor findings recorded by Sayari. Our team updated and reviewed previous 'Forced Labor' assessments for our selected manufacturers, created and established the evaluation matrix for Forced Labor ratings for each of our 34 companies using the Sayari data results and created and updated the Supply Chain Diagrams and Global Transportation Maps which channeled the SAYARI data results for more than a dozen companies. With the data gathered, we derived conclusions and generated directions for designers and researchers to consider as they take on the lens of forced labor and apply it to their work.

Franca Trubiano made presentations of the research at the University of Pennsylvania, ICSA conference in Antwerp, Belgium, and Columbia University GSAPP. A conference paper was published in the proceedings of the 2025 ICSA conference in Antwerp, Belgium. A paper for a book chapter was written for Volume Three of *Building Better – Less – Different*, "Sustaining Labor and Transforming Cities", title "You Found Forced Labor in your Material Supply Chain: Now what?", Volume Editor, Fall 2025.

PHASE 3 ACTIVITIES

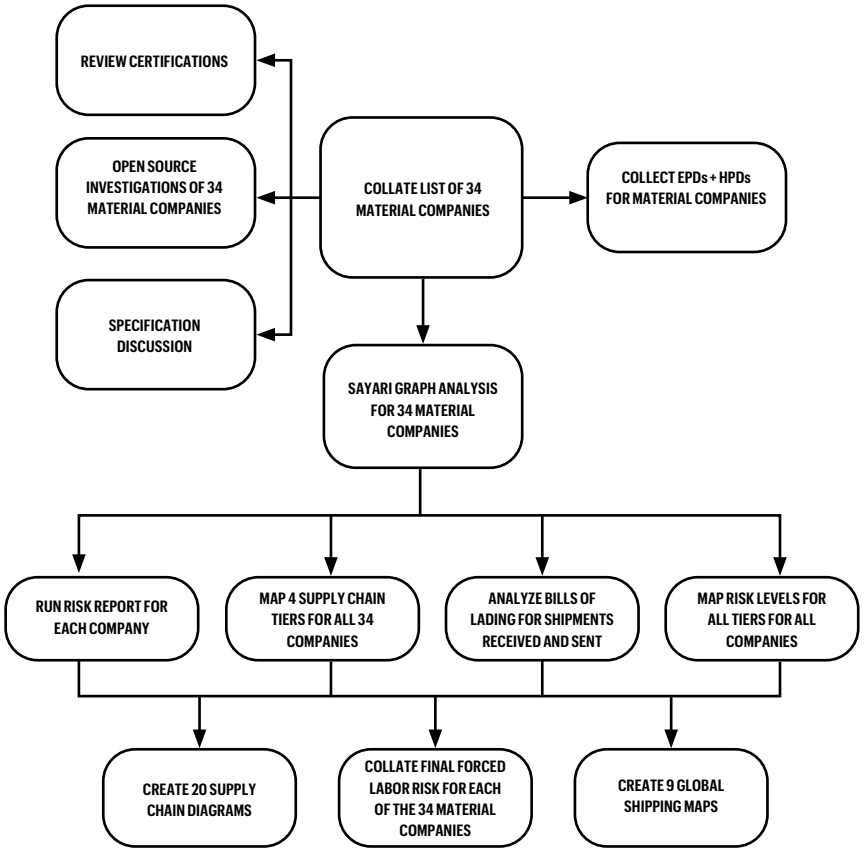


Figure 1.02, Phase 3 Activities

1.4 RESEARCH METHODS AND ACTIVITIES

1.4.1 Research Methodology

Research steps were developed as a proof-of-concept for investigating the probability and risk of forced labor along the building supply chain and material life cycle of designated landscape architecture materials. These included:

1. Identifying a minimum of five companies for (5) material products common in landscape architecture projects.
2. Identify the extent to which these products are used by New York City Parks.
3. Reviewing NYC Parks specifications for public sector contracts.
4. Review commonly available business-centered tools focused on industry certifications, due diligence protocols, and supply chain audits to identify the probability of said products and their materials for forced labor.
5. Identify and diagram all material components and manufacturing processes for the (5) chosen material products
6. Identify and diagram the origin and sourcing of each material in said products, across all tiers of the supply chain, from resource extraction to installation. (national, international, imported or not) of 34 companies.
7. Map the material flows for more than 50% of the at-risk supply chains and represent using global transportation MAPS the routes for 33% of the at-risk supply chains.
8. Catalogue the SAYARI forced labor risk profile along the building supply chain and material life cycle for all 34 companies.
9. Evaluate and represent the Forced Labor Risk for all 34 companies in our research profile.

1.4.2 Literature Review of Past Scholarship

The greater part of this literature review was completed at the beginning of our research process, during Phase 1, which ended in October 2024. It does not incorporate all the sources we acquired, reviewed, and assimilated during the research process. Those sources can be identified in the Endnotes that accompany the rest of this report and the comprehensive bibliography in section 8.0.

In addition, some aspects of this text have been published in a previously published paper presented in the summer of 2025 and titled, "Covering Ground: Identifying the Risk of Forced Labor in Five of the Most Specified Landscape Architecture Materials in the US."

The professional press covering architecture, landscape architecture, and structural and civil engineering has yet to fully acknowledge the very real presence of forced labor in the production of our buildings and structures.[14] While design professionals and consultants are rarely directly impacted by the illegal labor activities concealed in contracts between clients and builders, those operating more immediately in the business of building have a clearer financial and legal incentive to monitor the presence of forced labor in their practices.[15] For this latter group, an increasing number of resources are now available that help identify the conditions under which forced labor prospers.

Recent public-facing books on the subject that indicate the scale of the problem beyond the construction industry include Siddharth Kara's *Cobalt Red, How the Blood of the Congo Powers our Lives*, Laurie Parsons' *Carbon Colonialism, How rich countries export climate breakdown*, and Kevin Bales' *Blood and Earth, Modern slavery, ecocide and the secret to saving the world.*

Most critical has been investigative reporting on the subject conducted by academic research centers located in the United Kingdom. Recent publications from Sheffield Hallam University address various forms of forced labor in the manufacturing of solar cells, aluminum, and polyvinyl chloride typically found in flooring.[16] These include titles such as "In Broad Daylight, Uyghur Forced Labour and Global Solar Supply Chains," and "Built on Repression: PVC Building Materials' Reliance on Labor and Environmental Abuses in the Uyghur Region." In addition, researchers at Royal Holloway University of London have directed our attention to dangerous working conditions amongst international producers of brick masonry in their report, *Blood Bricks: Untold Stories of Modern Slavery and Climate Change from Cambodia.*[17]

When seeking guidance on which materials specified by landscape architects and civil engineers—for playgrounds, terraces, roadways, bike paths, sports fields, and for draining our waterways—are both sustainable and free of forced labor, a different set of sources is useful. The subject of tropical hardwoods used for ground cover has been in the news of late. The use of Ipe wood, for example, when building the first segment of the High Line in New York City, proved a highly charged decision.[18] Considered by some an environmentally

wise choice—given its durable performance characteristics—this exotic walnut is extracted from the Brazilian rainforest and hence not the best selection for sites of urban recreation if this contributes to devastating Amazonian hardwoods. Previous scholarship in this space includes Jane Hutton's article *Seeing Double.* [19] We were also inspired by Jane Hutton's process of following the supply chain of materials adopted in her book *Reciprocal Landscapes: Stories of Material Movement*, even if our work was not historical in nature.

Important resources for identifying forced labor risks include legislative acts passed in the United States, Europe, the United Kingdom, Canada, and Australia designed to curb, if not eliminate, the risk of forced labor in materials supply chains.[20]

Industry watchdogs, moreover, such as the CIOB - Chartered Institute of Building - in the United Kingdom, help us navigate information gathering between businesses that obfuscate data and those that call for greater transparency.[21] The 2022 report by COOKFOX Architects', "Survey of Labor Certifications for the Built Environment" is the most comprehensive recent resource focused on the building industry that identifies and analyzes business-centered certifications potentially helpful in measuring the risk of exposure to forced labor.[22] This work, substantially authored by John Russell Beaumont, offers a summary analysis of (51) certifications for assessing sustainable manufacturing and labor practices. (This work is reviewed in depth in section 3.1.1 COOKFOX "Survey of Labor Certifications for the Built Environment."

In addition, the Design for Freedom (DFF), "International Guidance & Toolkit" publication, issued by Grace Farms in 2024 introduces the subject of forced labor in the building industry both to a general audience and design and building professionals.[23] It helps set priorities for professionals who want to reduce the use of forced labor in their projects by explaining where the risks might be in the world and framing how professionals can go about avoiding them. This toolkit frames the legal landscape in which goods are purchased and regulated internationally so that practitioners can be aware of the laws currently in place. A total of twelve "At-Risk Materials" are discussed:

- Bricks
- Concrete
- Glass
- Metals: Aluminum, Cobalt, Copper, Steel and Iron
- Minerals: Gypsum, Mica, Silica
- Paints & Dyes
- Polysilicon & Solar Panels
- PVC
- Rubber
- Stone
- Textiles
- Timber

The synopsis for each material provides the context for where these raw materials are typically extracted or harvested from in the world and the labor conditions of each. They shed light on the fact that currently, many of these materials do not have associated, specific fair labor litigation or certifications that we can use to evaluate whether they are they forced labor free, especially those of us working in the US. When there are relevant certifications listed for each material an assessment of the efficacy of each certification is not provided. While it is helpful to see the global import and export figures for each material, it would be helpful to know which companies are most at risk for forced labor.

The toolkit itself offers a variety of resources for those working in the industry to track the risk of forced labor among companies, a questionnaire to engage manufacturers directly, a contract and letter designers can use to promote Design for Freedom Agenda within a project, overall lists of certifications per organization and per product, a list of supply chain mapping platforms and resources for tracking fair labor products within a construction project. Finally, a general specification for the use of fair labor products is included.

In what concerns the recommendation to use supply chain mapping platforms and resources, they are typically outside the price range for most landscape architects, and the one free supply chain tracing platform, Open Supply Hub, has little coverage of construction materials. In addition, none of the material sourcing platforms mentioned specifically encourage or call out forced labor-free materials in a way that would make them easily useful to designers. Including these platforms offers a hopeful sign, even if at present they are not entirely useful for finding materials free from forced labor.

Endnotes

[1] The Global Slavery Index, 2023, https://www.walkfree.org/global-slavery-index/; Forced Labor | U.S. Customs and Border Protection, n.d., https://www.cbp.gov/trade/forced-labor

[2] Forced Labor | U.S. Customs and Border Protection, n.d., https://www.cbp.gov/trade/forced-labor (Forced Labor | U.S. Customs and Border Protection, n.d.; U.S.C. Title 19 - CUSTOMS DUTIES, https://www.govinfo.gov/content/pkg/USCODE-2011-title19/html/USCODE-2011-title19.htm

[3] Walk Free Global Slavery Index, "Modern Slavery in United states," https://www.walkfree.org/global-slavery-index/country-studies/united-states/

[4] Walk Free Global Slavery Index, "Modern slavery in Japan Global Slavery Index 2023," Country Snapshot https://cdn.walkfree.org/content/uploads/2023/09/28091009/GSI-Snapshot-Japan.pdf

[5] The Global Slavery Index, 2023, https://www.walkfree.org/global-slavery-index/; Forced Labor | U.S. Customs and Border Protection, n.d., https://www.cbp.gov/trade/forced-labor

[6] Heather Timmons and J. Adam Huggins, "New York Manhole Covers, Forged Barefoot in India," *The New York Times*, November 26, 2007, https://www.nytimes.com/2007/11/26/nyregion/26manhole.html

[7] US Department of State, "2024 Trafficking in Persons Report," https://www.state.gov/reports/2024-trafficking-in-persons-report/

[8] Ibid.

[9] Ibid.

[10] Paul Koscak, "CBP Takes Aim at Forced Labor," https://www.cbp.gov/frontline/cbp-takes-aim-forced-labor#:~:text=For%20well%20over%20a%20century,or%20coffee%20beans%2C%20for%20instance.

[11] "CBP and the Trade Facilitation and Trade Enforcement Act of 2015 (TFTEA), Key Areas of Trade Facilitation and Enforcement," https://www.cbp.gov/trade/trade-enforcement/tftea; see also, US Customs and Border Protection, Forced Labor, https://www.cbp.gov/trade/forced-labor.

[12] US Customs and Border Protection, "Uyghur Forced Labor Prevention Act," https://www.cbp.gov/trade/forced-labor/UFLPA

[13] https://www.nycgovparks.org/about

[14] Louie, L., Cuffy, B., Welch, R., & Faircloth. B. 2023. "How Alternative Governance Models Can Help the Design Community Combat Forced Labor." *Design for Partnerships for Change*: 353-362. https://doi.org/10.1007/978-3-031-36993-3_28; LeBaron, G. 2021. "The Role of Supply Chains in the Global Business of Forced Labour." *Journal of Supply Chain Management* 57, (2): 29-42. https://doi.org/10.1111/jscm.12345; LeBaron, G., Lister, J., & Dauvergne.P. 2017. "Governing Global Supply Chain Sustainability through the Ethical Audit Regime." *Globalizations,* 14 (6): 958–975; Franco, M. A. 2022. "Invisible Labor: Precarity, Ethnic Division, and Transformative Representation in Landscape Architecture Work." *Landscape Journal,* 41 (1): 95–111; Sturlaugson, B. 2018. "What You Don't See Matters: Supply Chain Capitalism and the Architecture of Production." *In Crossings Between the Proximate and Remote: Fall Conference Proceedings*.

[15] Dodd, T., Guthrie, J., & Dumay, J, 2022. "Management Controls and Modern Slavery Risks in the Building and Construction Industry: Lessons from an Australian Social Housing Provider." *Business Accountability*, 35. https://doi.org/10.1016/j.bar.2022.101098; Jones, P. & Comfort, D. 2022. "Modern Slavery Statements and the UK's Largest Companies: An Exploratory Research Paper." *Property Management,* 40 (5): 658-670. https://doi.org/10.1108/PM-06-2021-0043; Pesterfield, C. & Rogerson, M. 2023. "Institutional Logics in the UK Construction Industry's Response to Modern Slavery Risk: Complementarity and Conflict." *Journal of Business Ethics*, https://doi.org/10.1007/s10551-023-05455-4.

[16] Murphy, L & Elimä, N. 2021. "In Broad Daylight, Uyghur Forced Labour and Global Solar Supply Chains." Sheffield Hallam University Helena Kennedy Centre for International Justice; Murphy, L. & Vallette, J. & Elimä, N. 2022. "Built on Repression: PVC Building Materials' Reliance on Labor and Environmental Abuses in the Uyghur Region." Sheffield Hallam University Helena Kennedy Center for International Justice: 11-18; Crawford, A. & Murphy, Laura. 2023. "Overexposed: Uyghur Region Exposure Assessment for Solar Industry Sourcing." Sheffield Hallam University Helena Kennedy Center for International Justice

[17] Brickell K., Parsons L., Natarajan, N., & Chann, S. 2018. *Blood Bricks: Untold Stories of Modern Slavery and Climate Change from Cambodia*. Royal Holloway University of London.

[18] Hutton, J. 2013. “A Trail of Stumps.” *Landscape Architecture Magazine*, (May 17, 2013), https://landscapearchitecturemagazine.org/2013/05/17/a-trail-of-stumps/; Parker, B. 2009. “High Line Called Out for Using Amazon Wood.” *Gothamist* (September 24, 2009)

[19] Jane Hutton, “A later phase of the High Line incorporated salvaged lumber, and the Parks Department has pivoted away from tropical hardwood procurement,” in Seeing Double, https://urbanomnibus.net/2020/04/seeing-double/. See also Jane Hutton in *Landscape Architecture Magazine*, https://landscapearchitecturemagazine.org/2013/05/17/a-trail-of-stumps/, and in *ArchDaily*, “First Hand on the Highline,” https://www.archdaily.com/28158/first-hand-on-the-highline.

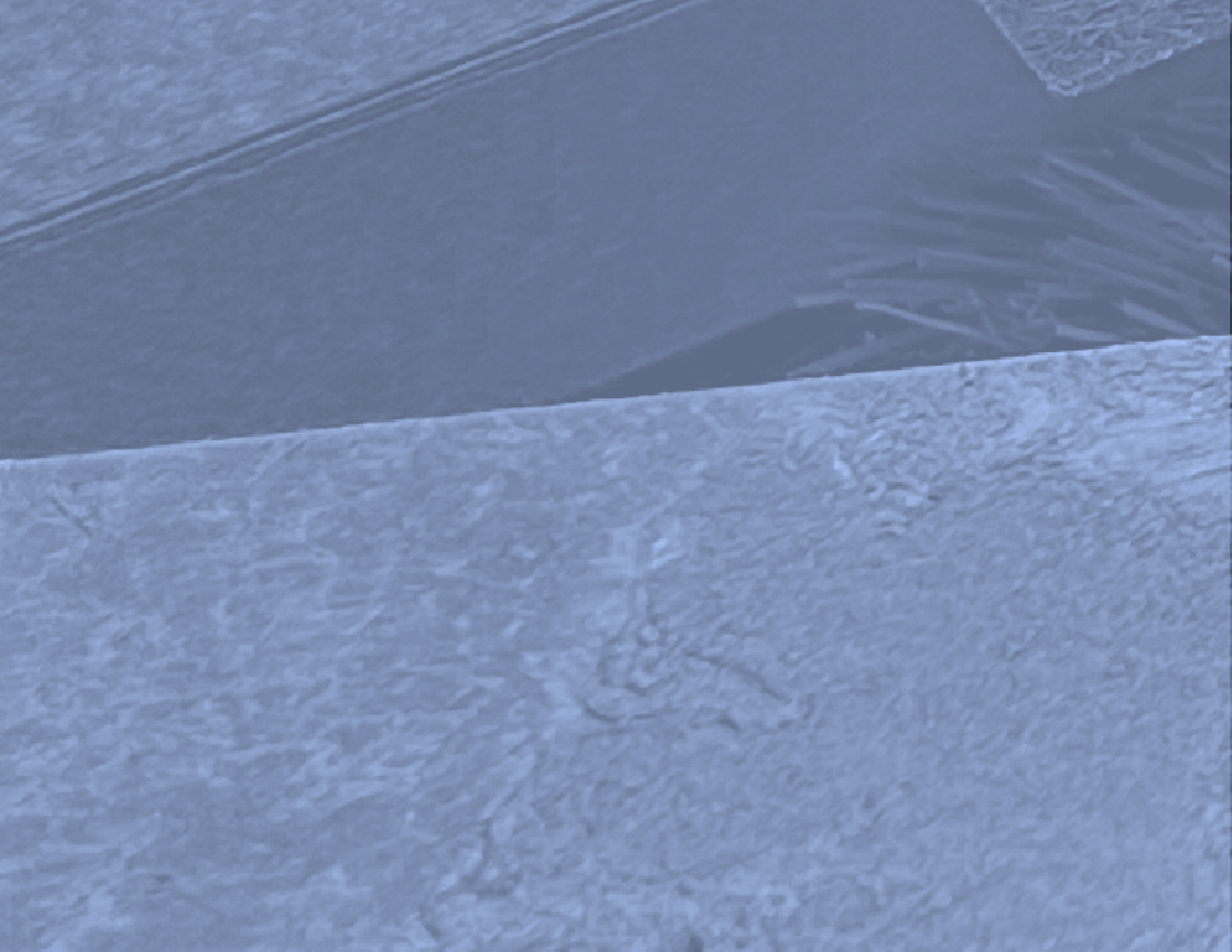
[20] Bhala, R. 2024. "The Forced Labor Revolution in U.S. International Trade Law." *International Lawyer*, 57 (2); Eustace, A. 2024. “The European Union’s forced labour regulation: Putting the ‘brussels effect’ to work for international labour standards.” *European Labour Law Journal*, 15(1), 144-165. https://doi.org/10.1177/20319525231221097 ; Valois, M.C. 2024. "Lessons Learned From The First Filing Year of Canada's Forced and Child Labour in Supply Chains Legislation." *Mondaq Business Briefing*, 19 June 2024

[21] CIOB, The Chartered Institute of Building. 2016. “Building a Fairer System, Tackling Modern Slavery in Construction Supply Chains.” https://d8.ciob.org/industry/research/Building-Fairer-System-Tackling-modern-slavery-construction-supply-chains; CIOB, The Chartered Institute of Building. 2018. “Construction and the Modern Slavery Act, Tackling Exploitation in the UK”. https://www.ciob.org/industry/research/State-of-Well-being-Construction-Industry

[22] COOKFOX Architects. 2022. “Survey of Labor Certifications for the Built Environment”. https://cookfox.com/wp-content/uploads/2022/04/COOKFOX_Survery-of-Labor-Certifications-for-the-Built-Environment_2022.pdf

[23] Garce Farms, “Design for Freedom (DFF), International Guidance & Toolkit”, (Grace Farms, 2024), https://www.designforfreedom.org/home/design-for-freedom-international-guidance-toolkit/

This page is intentionally left blank



2.0
Covering Ground: Forced Labor in Landscape Design

Portions of this text have been published in research papers produced by this research team and identified in this report.

2.1 BUILDING INDUSTRY AND FORCED LABOR

What is meant by 'forced labor' and in what ways do we encounter it in the supply chain of building materials and construction sites? How is this defined by governmental and para-governmental bodies, non-governmental agencies (NGOs), researchers, and members of the AEC industry? What is the evidence of, and remedies for, human rights violations (including forced labor) in the building industry?

Is there a shared, operational definition of the unlawful practice that is 'forced labor'? Is there a consensus on what it is, how to identify it, and how big is the problem? There is an internationally sanctioned vocabulary whose terms and definitions help to identify, characterize, and address instances of forced labor. Governments, para-governmental bodies, non-governmental agencies (NGOs), labor unions, and academic researchers agree on clear and unambiguous definitions of what constitutes forced labor including its various guises and appearances. Before defining forced labor, however, we recognize four major sites where workers are at risk of being imperiled in the building industry. The first includes all locations where material extraction takes place, as all building materials begin their life during a process of removal from the ground, be they fossil fuels, stones, or wood. The second is the concatenated network of manufacturing enterprises whose factories produce thousands of building products typically installed by other workers on building sites. The third is the building site itself whose laborers are contract-hired or recruited for the duration of their process of the project. The fourth and final site is that of waste, wherein refuse yards become the dumping grounds of all non-recycled content resulting from the demolition of buildings. For reasons of scope, this report addresses only questions of supply chain transparency in manufacturing.

According to the International Labour Organization (ILO)–a United Nations (UN) agency whose members include representatives from national governments, employers, and laborer organizations—tasked with setting labor standards for decent working conditions, forced labor includes all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered [themself] voluntarily.[1] All work whose fruits are destined for someone other than the person who labors, not freely chosen and imposed under threat or intimidation is considered forced labor. At the highest risk of which are impoverished and disadvantaged citizens, migrant workers, precarious peoples, women, and children. According to the ILO, there are eleven indicators of forced labor, including abuse, deception, restriction of movement, isolation, physical and sexual violence, intimidation and threats, confiscation of state-issued documents (passports, identity cards), wage withholding, debt bondage, poor working and living conditions, and excessive overtime.[2]

In the building industry, forced labor also takes the form of unpaid work or payment for work that is less than originally promised, required recruitment fees paid to employer or third-party agents, child labor, work that is subject to the rules of Kafala, forced migration or relocation for work, forced participation in non-work related activities, unhealthy and unsafe exterior working conditions, restricted right to self-assembly, psychological or physical coercion, and not being able to communicate one's concerns to independent third parties.[3]

According to the UN, Universal Declaration of Human Rights ratified in December 1948, as many as five separate articles speak to forced labor. Article 4, for example, acknowledges the basic human right that "*no one shall be held in slavery or servitude*".[4] Article 13 identifies that "everyone has the right to freedom of movement and residence within the borders of each state" as well as "*everyone has the right to leave any country, including his own, and to return to his country*"; an important article in the context of labor-based migration that accompanies the search for work on building sites. Article 20 states that "*everyone has the right to freedom of peaceful assembly and association*"; a human right that is often in question when laborers are punished for wishing to self-organize or unionize. Article 23 is the most explicit relative to labor rights, noting that everyone has the, "*right to work, to free choice of employment, to just and favorable conditions of work, ... to equal pay for equal work, ... to just and favorable remuneration, ... [and] to form and to join trade unions for the protection of his interests.*"[5]

Numerous ILO guidelines and standards exist for ameliorating the status of workers in the building industry, even as they recognize the heightened precarity of Indigenous peoples, dock workers, fishers, seafarers, domestic workers, mothers, and children.[6] Convention C029 - Forced Labour Convention, 1930 (No. 29) addresses forced labor directly, noting that the "*illegal exaction of forced or compulsory labour shall be punishable as a penal offence.*"[7] Lastly, in 1998, with increasing pressures to recognize the growing liberation of labor and the global reach of corporate supply chains, the ILO adopted the 1998 "ILO Declaration on Fundamental Principles and Rights at Work" which all member states are subject to. Its fundamental tenets are: "*freedom of association, ...right to collective bargaining; the elimination of all forms of forced and compulsory labour; ... abolition of child labour; ... elimination of discrimination...; [and, the right] to a safe and healthy working environment.*"[8]

Eradicating forced labor is also a tenet central to the goals of the UN 2030 Agenda for Sustainable Development. As outlined in Sustainability Goal # 8, eradicating poverty and achieving a better standard of living for all requires we "*promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.*"[9] In this, we must, take immediate and effective measures to eradicate forced labor, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labor, including recruitment and use of child soldiers.[10]

Wherever necessary, direct actions should "*protect labor rights and promote safe and secure working environments for all workers.*"[11] In addition, the UN's "Guiding Principles on Business and Human Rights," sanctioned by the UN Human Rights Council in 2011, calls upon all businesses to "Protect, Respect and Remedy" the human rights of those they employ in the process of conducting business and seeking to maximize profits.[12] Nation-states are responsible for protecting the rights of those who labor in their countries; so too must businesses ensure that labor rights are respected in the course of doing business. The UN's "Guiding Principles" are voluntarily adopted by companies that seek to establish a competitive advantage by way of social awareness. Corporate audits, certifications, and due diligence in the procurement of goods and services that ensure slavery-free supply chains across all tiers of a company's procurement profile are the gold standard of ethical business.

With specific reference to the AEC industry, the ILO acts as an information convener and conduit for international labor unions such as the Building and Wood Worker's International (BWI bwint.org), UITBB (Union internationale des syndicats des travailleurs du bâtiment, du bois et des matériaux de construction, uitbb.org), and contractor organizations including the Confederation of International Contractors' Associations (CICA, cica.net), the European Construction Industry Federation (FIEC, fiec.eu), the International Federation of Asia and Western Pacific Contractors' Associations (IFAWPCA, ifawpca.com), The Associated General Contractors of America (AGC, agc.org), and the Canadian Construction Association (CCA, cca-acc.com).

2.2 HISTORY AND CONTEMPORARY CONDITIONS OF FORCED LABOR

How bad is the problem of forced labor in the building industry? According to the 2023 "Global Slavery Index" by the Australia-based non-profit 'Walk Free,' "*twenty-eight million people are subject to forced labor with the highest incidences in North Korea, Saudi Arabia, Turkey, UAE, and Russia*".[13] The monetary value of this illegal activity in modern slavery, and of importing "at-risk" goods for countries in the G20 is in the billions. The ILO claims that close to 25 million people are at risk of forced labor, the greatest number of whom (83%) labor in the private sector, resulting in billions of dollars of profits garnered illegally.[14] Moreover, 4 million people experience forced labor at the hands of governments and state actors.[15] According to Human Rights Watch (HRW)—an NGO whose lawyers, journalists, policy analysts, and on- the-ground observers monitor human rights abuses across the world, collecting front-line data and personal narratives— injustices in the building industry continue to impact the lives of millions. Captured in their report from 2006, "Building Towers, Cheating Workers, Exploitation of Migrant Construction Workers in the United Arab Emirates" five hundred thousand migrant construction workers were subject to life-threatening working conditions.[16] As stated by HRW, "behind the glitter and luxury" that is modern Dubai are the hardships of migrant construction workers who, "*present a much less attractive picture of wage exploitation, indebtedness to unscrupulous recruiters, and working conditions that are hazardous to the point of being deadly.*"[17]

In their 2017 report, "Qatar: Take Urgent Action to Protect Construction Workers, FIFA, National Associations Should Press Qatar on Heat Risks, Preventable Deaths," HRW alerted the world to workers at risk of heat stroke and related cardiac arrest.[18] And in 2012, HRW published "Building a Better World Cup, Protecting Migrant Workers in Qatar Ahead of FIFA 2022," a 150-page report that forecast the labor-based exploitation of the more than a million workers who migrated to Qatar to build the infrastructure for the 2022 World CUP.[19] At the very center of this was the severely compromised process of recruiting said workers wherein male workers originating from southeast Asia (India, Pakistan, Bangladesh, and Nepal) were required to pay exorbitant fees to agents in the thousands of dollars, indebting themselves and imperiling their lives and those of their families for years.

According to 'Walk Free,' the United States could import close to 170 million dollars of forced labor products, while Germany could import as much as 44 million dollars in slavery-tainted electronics, solar panels, textiles, and timber, a good deal of which is destined for the building industry. In the face of such staggering numbers, what are the currently available tools, protocols, and data resources of possible use to the industry to help it evaluate its exposure risk to forced labor? [20]

2.3 LAWS THAT APPLY IN THE UNITED STATES AND ABROAD

The United States, the United Kingdom, and the European Union all have laws and guidelines governing forced labor in the material supply chain of products sold in their respective countries.[21] In the United States, Customs and Border Protection (CBP) has the legal right to enforce the confiscation of imported goods at their point of entry, allegedly produced using forced labor (United States Customs and Border Patrol n.d.). Subscribing to the ILO and UN definition of forced labor, the US CBP seizes goods in shipments entering the country if believed to have been produced illegally. In "*implement[ing] Section 307 of the Tariff Act of 1930 (19 U.S.C. §1307),*" CBP has the power to issue a Withhold Release Order (WRO), that identifies suspected products. The law states that, "*all goods, wares, articles, and merchandise mined, produced, or manufactured wholly or in part in any foreign country by convict labor or/and forced labor or/and indentured labor under penal sanctions shall not be entitled to entry at any of the ports of the United States.*"[22] In addition, the Uyghur Forced Labor Prevention Act (UFLPA) bans from US entry all products originating from this region in China of companies and entities explicitly banned via the-

> "*list of entities in Xinjiang that mine, produce, or manufacture wholly or in part any goods, wares, articles and merchandise with forced labor*"; the "*list of entities working with the government of Xinjiang to recruit, transport, transfer, harbor or receive forced labor or Uyghurs, Kazakhs, Kyrgyz, or members of other persecuted groups out of Xinjiang*"; the "*list of facilities and entities, including the Xinjiang Production and Construction Corps, that source material from Xinjiang or from persons working with the government of Xinjiang or the Xinjiang Production and Construction Corps for purposes of the ''poverty alleviation'' program or the ''pairing-assistance'' program or any other government-labor scheme that uses forced labor list.*"[23]

The United Kingdom (UK) passed a 'Modern Slavery Act' in 2015 to enforce, charge, and prosecute those charged with modern slavery, as well as to compensate those victimized by the crime. The Act "*requires businesses over a certain size to disclose each year what action they have taken to ensure there is no modern slavery in their business or supply chains.*" [24] Different from the US, the UK acknowledges that a significant degree of forced labor is found in the UK. According to The Guardian, as many as thirteen thousand people are enslaved in the UK in the sectors of "*agriculture, hospitality, fishing, private homes, brothels, nail bars and cannabis farms.*" [25] According to an AEC industry report by the Chartered Institute of Building "Construction and the Modern Slavery Act, Tackling Exploitation in the UK," forced labor in the building industry has been noted in physically strenuous jobs such as laying of driveways, property repairs, building demolition, block paving, and waste recycling.[26]

In 2021, the European Union (EU) issued its "Guidance" to conduct "Due Diligence" reviews of forced labor risk in the material supply chains of products (European Union 2023). Even if non-binding and hence unenforceable by law, the Guidance establishes a "*framework to investigate the use of forced labour in companies' supply chains. If it is proven that a company has used forced labour, all import and export of the related goods would be halted at the EU's borders and companies would also have to withdraw goods that have already reached the EU market.*"[27] Moreover, as part of the EU's 'Directive on Corporate Sustainability Due Diligence', aspects of human rights (including labour rights and justice) are considered alongside questions of environmental sustainability.[28] On December 12th, 2024 , the EU finally passed legislation against forced labor.[29] While the legislative power of national governments is essential in the space of human rights, encouraging and incentivizing voluntary changes and the best business practices is also important.

In January 2024, The Canadian Modern Slavery Act (CMSA) went into effect, legislating the requirement of companies to report annually their risks of exposure to modern slavery (and child labor) in the supply chain of the products they produce or import in Canada. Bill S-211, applies to all companies that do business in the country (manufacturing, selling, or distributing goods) including those listed on the Canadian stock exchange, and those with addresses and assets in Canada.[30] Companies are required to file a report with the Minister of Public Safety and Emergency Preparedness disclosing their modern slavery risks and steps to mitigate said risks.[31] The goal of these reports is to achieve a higher degree of transparency in business and material supply chains by disclosing a company's processes in preventing and reducing risk in any part of the manufacturing of goods when offering detailed information on the various steps of production and material origins, on company policies and due diligence processes, when highlighting the part(s) of the business that may be at risk, steps taken to assess and manage risk, measures for remediating said risks, information on employee training, and assessment mechanisms for evaluating the effectiveness of one's actions.[32]

Below is a list of international laws and compliance mechanisms associated with forced labor sourced from the STRT Slavery & Trafficking Risk Template (Version 3.3). For a comprehensive list see https://www.socialresponsibilityalliance.org/strt.

- *"The US Federal Acquisition Regulation (FAR) final rule on Combating Trafficking in Persons (52.222-50)*
- *The UK Modern Slavery Act (Section 54 - Transparency in Supply Chains)*
- *The California Transparency in Supply Chains Act (SB657)*

- *The EU Non-Financial Reporting Directive*
- *French Loi relative au devoir de vigilance des societes meres et des entreprises doneuses d'ordre (Loi 2017-399)*
- *Countering America's Adversaries Through Sanctions Act (CAATSA)*
- *The Australia Modern Slavery Act (No. 153, 2018)*
- *Section 307 of the US Tariff Act and related regional-specific Acts*
- *Canada Customs Tariff Act (No. 9897.00.00)*
- *Lieferkettensorgfaltspflichtengesetz (German Act on Corporate Due Diligence Obligations in Supply Chains)*
- *Åpenhetsloven (Norwegian Transparency Act)*
- *Article 964 of the Swiss Code of Obligations (Obligationenrecht) (Swiss Conflict Minerals and Child Labor Due Diligence Ordinance)*
- *Canada's Fighting Against Forced Labour and Child Labour in Supply Chains Act*
- *Mexico's Forced Labour Regulation"*[33]

2.4 BUSINESS CENTERED TOOLS

Business-centered industry certifications are now essential for the business of sustainability, just as they can be for forced labor. Certifications facilitate information gathering, professional awareness, and industry peer review of best practices. The long list of third-party certifications associated with sustainability only continues to grow with every passing year: BREEAM, LEED, WELL Building Standard, Green Globes, ENERGY STAR, Passive House, CASSBEE, GREENGUARD, Cradle to Cradle are but a few (Vierra n.d.). Indeed, the industry is ever more aware of the need to measure the performance of its environmental claims, even while inundated with assessment tools whose data is rarely interoperable or comparable. In the end, the continued fragmentation of sustainability audits undermines the goals of sustainability. How might this be avoided in the context of forced labor audits?

In 2022, John Russell Beaumont of COOKFOX Architects published the "Survey of Labor Certificates for the Built Environment."[34] This 36-page report identifies available business tools for evaluating the risk of forced labor in building material supply chains. In reviewing fifty current certifications, findings are communicated via a matrix that indicates the presence of client input, member network, survey, field inspections, remote research, automated, public records, regional risk, and tiered analysis. Beaumont identifies three main categories of certifications:

- Supply Chain Management (SCM) evaluations
- Supplier Certifications
- Independent Evaluations

SCM involves the introduction of proprietary third-party services for analyzing the steps in a company's supply chain for facilitating 'Due Diligence' reporting and compliance with various 'Modern Slavery Acts.' Supplier Certifications typically originate from within industry groups to ensure greater transparency and sales confidence. Lastly, Independent Evaluations are those made by non-business related, non-profit organizations including The Walk Free organization with its Global Slavery Index, the KnowTheChain Benchmark Methodology common in the garment industry, and the Trafficking in Persons Report issued by the US government. The COOKFOX "Survey of Labor Certificates" is the first of its kind, and an essential resource for the AEC. (A detailed review of this source is offered in section 3.1.1 of this report).

Supply chain auditing is a distinct feature of certifications that facilitate the identification of measurable and verifiable data. However, while business

entities charged with (repeatedly) manufacturing the same product have greater access to the supply chain of said products, sub-contractors, builders, engineers, and architects are several 'tiers' removed from product manufacturing. This makes the auditing, evaluating, and remedying of instances of forced labor in the building industry vastly more complex. Members of the AEC industry can, however, leverage this process by being informed consumers. In the same way that one may choose not to purchase branded gear from a company cited at high risk for forced labor in their material supply chains, so too one might refrain from specifying suppliers of concrete, wood, stone, and aluminum.

AEC members are actively reviewing auditing interfaces commonly used for general manufacturing for possible compatibility with the building industry, even as important differences exist. While some third-party auditors collect self-reported information, others employ independent on the-ground observers; while some conduct 'desk audits' to corroborate company claims, and others deploy algorithms to automate the monitoring.[35] AEC professionals of the Design for Freedom (DFF) Working Group at Grace Farms, of which Franca Trubiano was a member, were involved in spring 2024 in an information-gathering project that investigated more than a dozen third-party auditing platforms for possible data interoperability in service to a shared culture of Environmental, Social, and Corporate Governance (ESG) management and compliance. The outcome of which was reported in the Grace Farms Foundation "Design for Freedom International Guidance & Toolkit."[36] During an interview with a director from Verité.org, the enormity of the task of auditing forced labor risks in the building industry was notable. Not only is it difficult to get access to front-line laborers in Tier 3 and 4 companies, but it is even more complicated when this level of analysis is required for products that are used only once in a singular building project. How difficult is it to map the material supply chain for a be-spoke building envelope commissioned for Dubai, designed in New York City, and whose parts are manufactured in Asia, Europe and Southeast Asia?

In response, Verité offers two separate tools. The 'Responsible Sourcing Tool (RST)' (responsiblesourcingtool.org) was created following the passing of US federal acquisition regulation that requires all government contracts for building overseas to ensure its contractors submit an anti-trafficking plan. The second Verité tool is CUMULUS (verite.org/cumulus), a digital interface compliance tool focused on recruitment fees as the key indicator of forced labor. This assessment is predicated on the hypothesis that if a worker is forced to pay fees for being hired, this is a clear sign that they will be at risk for forced labor. When CUMULUS investigates a particular company for its recruitment practices, it requests that the company submit receipts in evidence that they paid for recruiting their workers. If workers are burdened with this cost, this is only the first of many possible injustices.

Social LCA

Social LCA is the third tool at our disposal. As previously noted, sustainable design and construction could offer important resources of use for those committed to measuring forced labor risks in the building industry. One such resource is the 'accounting' infrastructure identified with building-centered Life Cycle Assessments. In the same way that environmentally contingent metrics can be rigorously connected with many aspects of a building's supply chain, so too can worker welfare be quantitatively measured to enrich the definition and practice of LCA. According to the United Nations Environment Program (UNEP), Social Life Cycle Assessments (S-LCA) capture important qualitative stakeholder and community-based values, observations, and evidence of lived inequalities that would otherwise be lost when only reviewing the material and energy expenditures of supply chains.[37] Of the five different stakeholder voices considered in S-LCA, worker rights are included alongside those of the local community, value chain actors, consumers, and society.[38] UNEP and S-LCA includes topics such as, "*Freedom of association and collective bargaining, Fair salary, Forced Labor, Equal opportunities/ discrimination, Health and safety, Social benefits/social security, and sexual harassment.*"[39] Including socially determined variables when calculating lifecycle assessment is a promising source for quantitative information on labor practices. This does, however, require a significant investment in the collection of on-the ground verifiable data. Building material supply chain certifications, audits, and S-LCA tools help us measure the risk of forced labor in the AEC. Conversely, they are not always effective for identifying critical hotspots whose conditions are not measurable using business-centered tools.

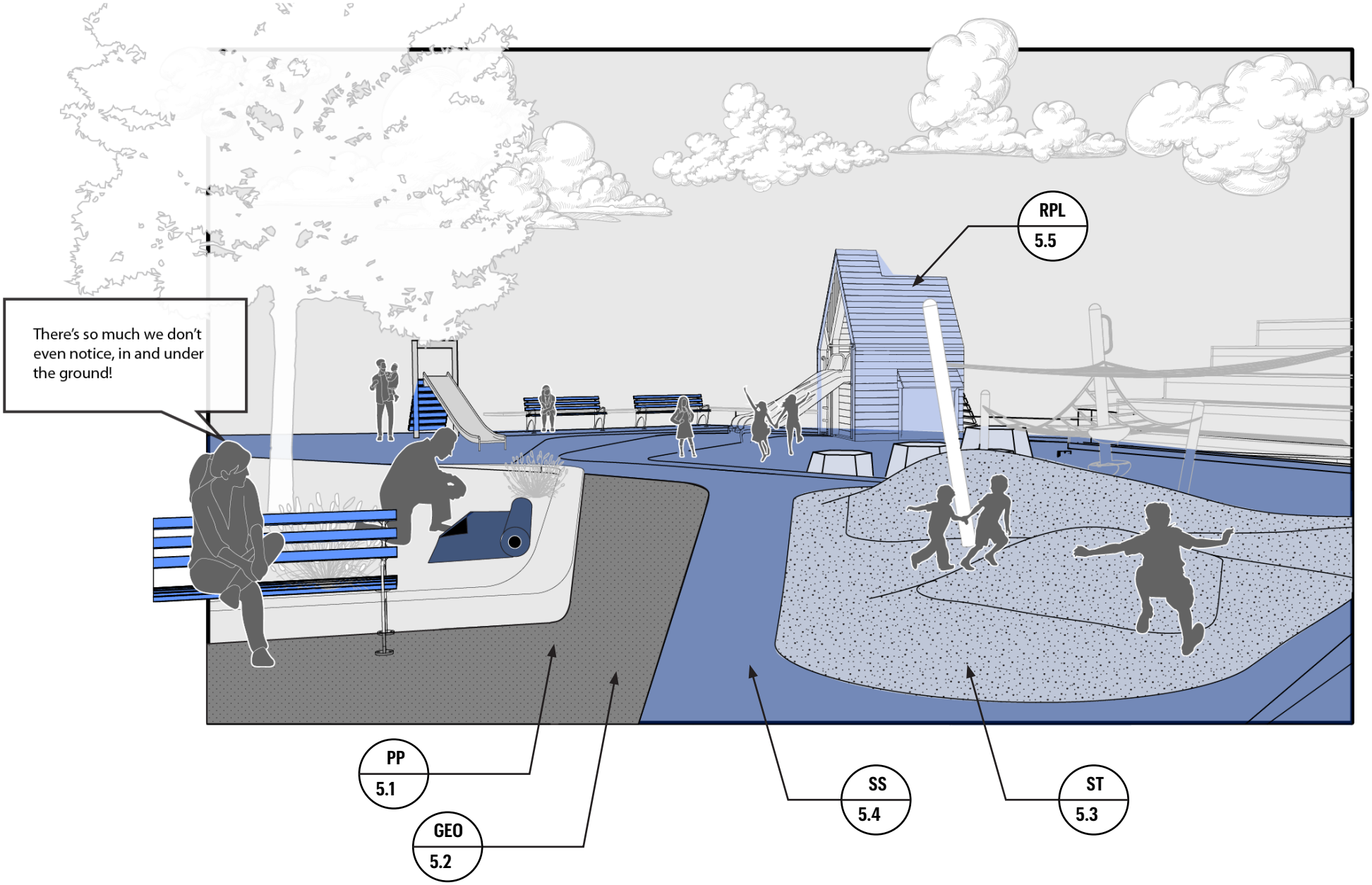


Figure 2.01, Typical Playground Materials, Credit MNLA

2.5 IDENTIFICATION OF LANDSCAPE MATERIALS

2.5.1 Material Choices

Children joyfully playing on rubber playground surfaces may seem like a common sight, but beneath the surface lies a disturbing reality; the geotextiles, safety surface, and synthetic turf upon which children play were likely manufactured using forced labor. The rubber, for example used in the making of the colorful and attractive safety surfaces is commonly extracted through the forced labor of children subjected to hazardous conditions, and adults working in contexts without an enforceable minimum wage. Synthetic turf bears one of the highest risks for forced labor and yet this material and others are commonly specified by landscape architects for playgrounds, sports fields, and the like.

To build upon, yet avoid replicating, work done and in progress by others, the research by MNLA and Penn focuses on materials specific and unique to the Landscape Architecture profession. Furthermore, we have researched materials that are commonly and widely employed by landscape architects, both in New York City and across the country. Because materials such as concrete and tropical hardwoods have already been significantly investigated, we chose to focus on:

- **Permeable Pavers (PP)**
  With continued, increasing concerns about stormwater management and climate change, cementitious permeable paver systems have grown in popularity within the landscape architecture profession for several reasons: they decrease the overall impervious area on the ground; reduce surface runoff; mitigate pollutants; alleviate demands on conventional drainage structures.

- **Geotextile Filter Fabric (GEO)**
  Often invisible in finished landscape projects, geotextiles are used extensively in landscape construction. They serve several critical purposes including but not limited to suppressing weeds, controlling soil erosion, stabilizing slopes, and improving drainage.

- **Synthetic Turf (ST)**
  This is a polymer-based version of sod/grass upon which children and adults play all manner of outdoor sports and re-create. While initially more expensive to install, synthetic turf is said to save maintenance costs as it does not require weeding, watering, fertilizing or mowing. This makes it a compelling choice for landscape architects, communities and clients. It withstands high use, while offering greater access during a variety of weather conditions.

- **Rubber Safety Surface (SS)**
  One of several options allowed by code within playgrounds, “rubber” safety surface is a popular choice by landscape architects. This surfacing material meets the critical safety requirements established to protect children within fall zones, and it is durable and easy to maintain.

- **Recycled Plastic Lumber (RPL)**
  For both maintenance and durability reasons, plastic lumber is widely used within the field of landscape architecture. Unlike natural wood, plastic lumber has a lower incidence of cracking, breaking or splintering. Easy to maintain, it is also water- and insect- resistant and does not contribute to deforestation. Many manufacturers employ recycled plastics, marketing this product as a sound environmental option.

2.5.2 Ubiquity and Invisibility of Polymers

Polymers are not sufficiently discussed in design and construction industries, in part, because they are invisible when synthesized in factories. They are, however, a serious source of forced labor in materials supply chains associated with the landscape architecture.

Landscape architects design with plants, trees, shrubs, and flowers: or so it assumed. In fact, nearly everything in the landscape architect’s repertoire that touches the ground, other than topsoil, is made of either cementitious materials, bitumen and its by-products, or plastics. This is far from hyperbole: parking spaces, concrete curbs, planters, benches, and play surfaces are predominantly made with non-biogenic materials.

Geotextile fabric, whether woven or nonwoven, is made of synthetic polymers such as polypropylene, polyester, polyethylene, or polyamide (nylon). Synthetic turf is comprised of four different polymer layers; blades of polyethylene, polypropylene, or nylon, backing of polyurethane or latex, an infill, or “crumb”, of recycled rubber tire pellets (in rare cases, organic cork, olive pits, or coconut fibers are used), and a drainage layer of synthetic polymer geotextile. Safety surface is commonly made of natural or synthetic rubber whereas recycled plastic lumber is alternatively made of both high and low-density polyethylene, polyvinyl chloride, polypropylene, polystyrene, polylactic acid, and acrylonite butadiene styrene. Even the most cementitious of materials is identified with polymers. We did not expect to find polymers embedded within concrete precast, permeable pavers. But in essence, the

making of these products would not be possible without the use of plasticizer additives. Figure 2.02, for example, graphically portrays the physical process of the creation of polyethylene.

Hence, in the name of design and high performance, landscape architects use plastics to cover, blanket, and smother the surface of the earth. Raw materials are extracted from the ground, synthesized into chemical blends, and stretched to throttle the organic soil upon which they lay. In this, they imperil the environment, but equally the lives of those who labor upstream at the origins of the manufacturing process.

The petrochemical companies that supply the materials at the core of their production are at elevated risks for sanctions, political exposure, export controls, and forced labor.[40] We need only consider the most recent story of BASF—a world leader in construction grade polyurethanes (PU), polystyrenes (EPS), polyethylene (PE), polypropylene (PP), acrylics and coatings, adhesives and sealants—alleged to have participated in questionable labor practices involving their manufacturing plant in Xinjiang, China.[41] BASF, however, is far from alone, as many petrochemical companies have subsidiaries and do business in this region of the world. And yet we continue to avoid acknowledging the extent to which petrochemicals have smothered the earth, embedded in nearly every building material for the purpose of advanced performance. Because most plastics are invisible to us, we rarely consider the extent to which they are the source of forced labor.

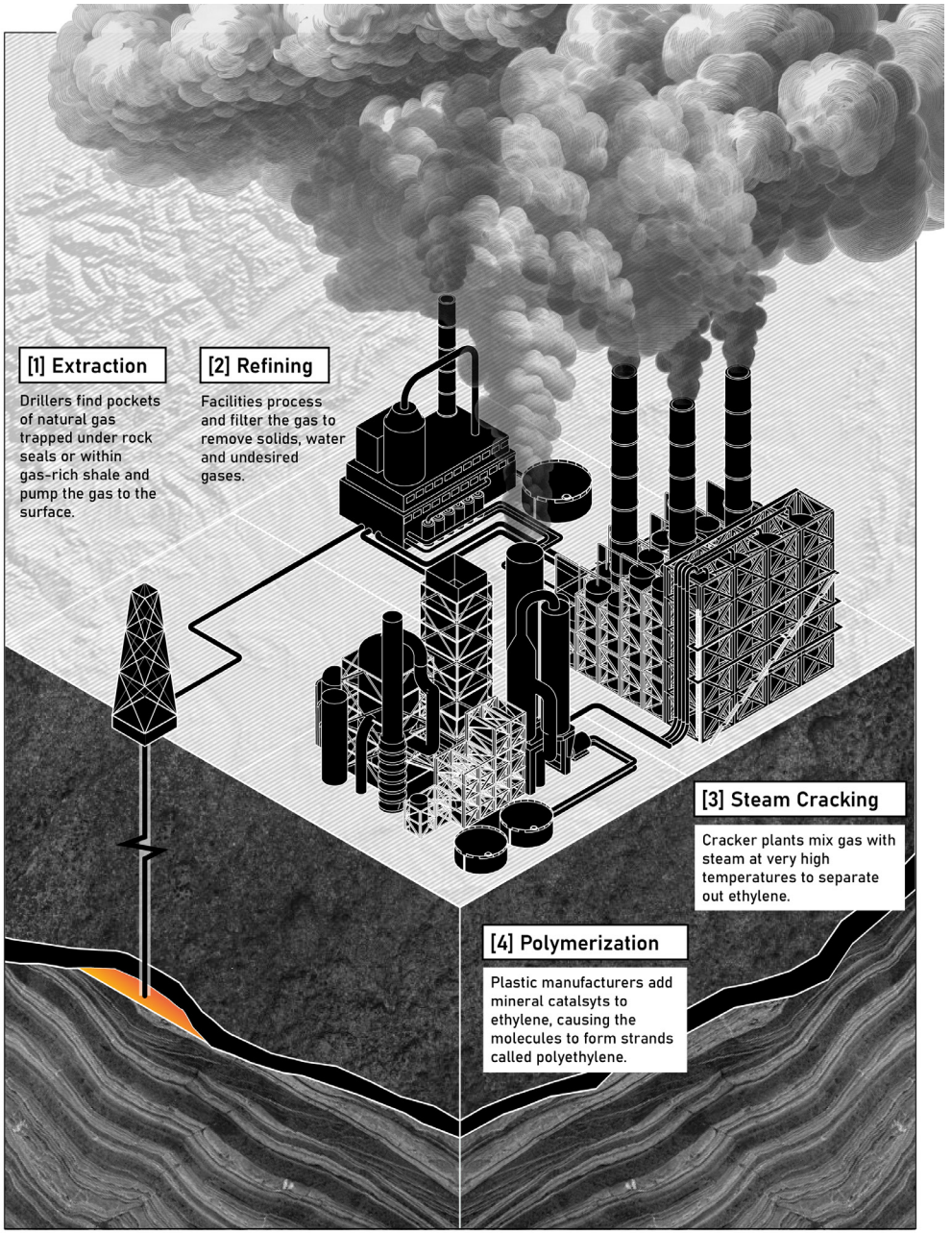


Figure 2.02, Polyethylene Strand Generation, Credit MNLA

Endnotes

[1] Ruwanpura, Kanchana N., and Pallavi Rai. 2004. *Forced Labour: Definition, Indicators and Measurement. Working Paper.* Geneva: International Labour Office; International Labour Organization. 1930. *C029 - Forced Labour Convention (No.29)*, https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C029.

[2] International Labour Organization. n.d.b. *International Labour Standards on Forced Labour*. Accessed March 3, 2025. https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/forcedlabour/lang--en/index.htm.

[3] International Labour Organization. 1957. *C105 - Abolition of Forced Labour Convention (No. 105).* https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:::NO:12100:P12100_ILO_CODE:C105:N.

[4] United Nations. 1948. *Universal Declaration of Human Rights*. https://www.un.org/en/about-us/universaldeclaration-of-human-rights.

[5] Ibid

[6] International Labour Organization. n.d.b. *International Labour Standards on Forced Labour*. Accessed March 3, 2025. https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/forcedlabour/lang--en/index.htm.

[7] International Labour Organization. 1930. *C029 - Forced Labour Convention (No.29).* https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C029.

[8] (International Labour Organization 2022). For a critique of the 1998 Declaration, see Alston, Philip. 2004. "Core Labour Standards' and the Transformation of the International Labour Rights Regime." *European Journal of International Law* 15 (3): 457-521.

[9] United Nations. n.d. *Sustainable Development Goal 8: Promote Sustained, Inclusive and Sustainable Economic Growth, Full and Productive Employment and Decent Work for All*. Accessed March 20, 2025. https://www.un.org/sustainabledevelopment/economic-growth/

[10] Ibid.

[11] Ibid.

[12] Office of the United Nations High Commissioner for Human Rights (OHCHR). 2011. *Guiding Principles on Business and Human Rights*. New York, Geneva: United Nations. https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf.

[13] Walk Free. *Global Slavery Index 2023*. https://cdn.walkfree.org/content/uploads/2023/05/17114737/Global-Slavery-Index-2023.pdf

[14] International Labour Organization. n.d.b. *International Labour Standards on Forced Labour*. Accessed March 3, 2025. https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/forcedlabour/lang--en/index.htm.

[15] Ibid.

[16] Human Rights Watch. 2006. *Building Towers, Cheating Workers: Exploitation of Migrant Construction Workers in the United Arab Emirates.* November 11. https://www.hrw.org/report/2006/11/11/building-towers-cheatingworkers/exploitation-migrant-construction-workers-united

[17] Ibid.

[18] Human Rights Watch. 2017. *Qatar: Take Urgent Action to Protect Construction Workers, FIFA, National Associations Should Press Qatar on Heat Risks, Preventable Deaths.* September 27. https://www.hrw.org/news/2017/09/27/qatar-take-urgent-action-protect-construction-workers

[19] Human Rights Watch. 2012. *Building a Better World Cup: Protecting Migrant Workers in Qatar Ahead of Fifa* 2022. June 12. https://www.hrw.org/report/2012/06/12/building-better-world-cup/protecting-migrant-workersqatar-ahead-fifa-2022.

[20] Walk Free. *Global Slavery Index 2023*. https://cdn.walkfree.org/content/uploads/2023/05/17114737/Global-Slavery-Index-2023.pdf

[21] Fanou, Temisan. 2023. "Literature Review: Forced Labour Import Bans." *Governing Forced Labour in Supply Chains (GFLC).* January 5. https://www.gflc.ca.

[22] United States Congress. 2021. *Title 19 of the United States Code, Chapter 4, Subtitle II, Part I, Section 1307.* https://www.govinfo.gov/content/pkg/USCODE-2021-title19/html/USCODE-2021-title19-chap4-subtitleII-partIsec1307.htm.

[23] See US Homeland Security, "UFLPA Entity List", https://www.dhs.gov/uflpa-entity-list

[24] United Kingdom. 2015. *Modern Slavery Act.* Accessed March 20, 2025. https://www.gov.uk/government/collections/modern-slavery-bill.

[25] Kelley, Annie. 2015. "The UK's new slavery laws explained: what do they mean for business?" *The Guardian,* December 14, 2025.

[26] Chartered Institute of Building (CIOB). 2018. "Construction and the Modern Slavery Act: Tackling Exploitation in the UK." 23-27.

[27] European Union. 2023 "Towards an EU ban on products made with forced labour." Accessed March 3, 2025. https://www.europarl.europa.eu/news/en/press-room/20231016IPR07307/towards-an-eu-ban-on-productsmade-with-forced-labour.

[28] European Commission. n.d. "Corporate sustainability due diligence: Fostering sustainability in corporate governance and management systems." Accessed March 3, 2025. https://commission.europa.eu/businesseconomy-euro/doing-business-eu/corporate-sustainability-due-diligence_en.

[29] White & Case. " EU Adopts Forced Labour Ban: 8 Things to Know" https://www.whitecase.com/insight-alert/eu-adopts-forced-labour-ban-8-things-know#:~:text=The%20prohibition%20is%20concerned%20with%20the%20entire,the%20product%20at%20any%20of%20those%20stages.

[30] An Act to enact the Fighting Against Forced Labour and Child Labour in Supply Chains Act and to amend the Customs Tariff. See also the Government of Canada website, "Forced Labour in Canadian Supply Chains," https://www.publicsafety.gc.ca/cnt/cntrng-crm/frcd-lbr-cndn-spply-chns/index-en.aspx. See also Jordan Deering et al, "Reporting obligations under new Canadian modern slavery legislation: What does a multinational business need to know?" https://www.dlapiper.com/en/insights/publications/practical-compliance/2023/reporting- obligations-under-new-canadian-modern-slavery-legislation#1.

[31] Ibid.

[32] Government of Canada website, "Forced Labour in Canadian Supply Chains," https://www.publicsafety.gc.ca/cnt/cntrng-crm/frcd-lbr-cndn-spply-chns/index-en.aspx.

[33] STRT website, "The Slavery and Trafficking Risk Template," https://www.socialresponsibilityalliance.org/strt/

[34] Russell Beaumont, "Survey of Labor Certificates for the Built Environment, New York: COOKFOX Architects.

[35] Ibid.

[36] See Interoperability Chart, "Design for Freedom International Guidance & Toolkit," Section 3 – Toolkit: 124. https://www.designforfreedom.org/home/design-for-freedom-international-guidance-toolkit/

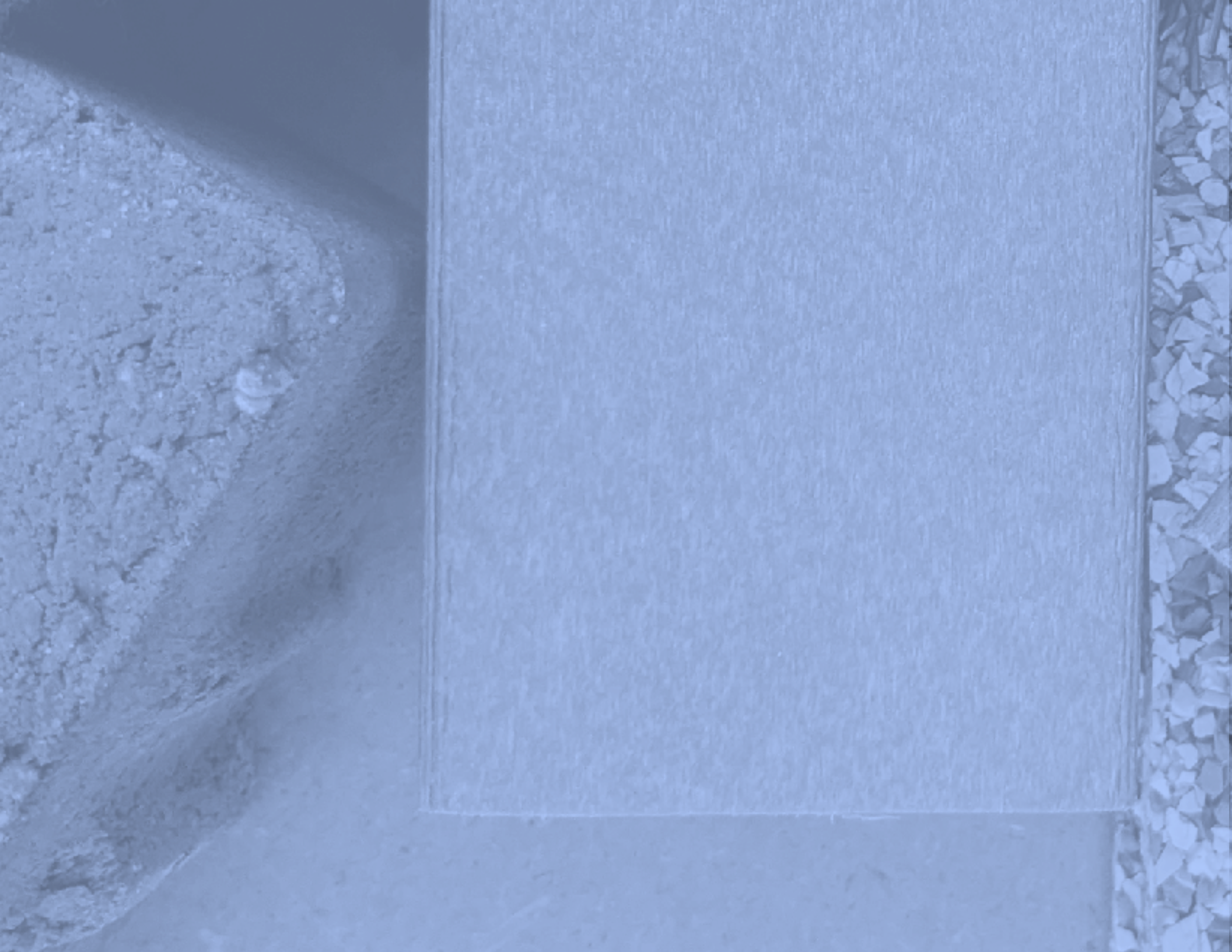
[37] Life Cycle Initiative, UNEP and Social Alliance. 2021. *Methodological Sheets for Subcategories in Social Life Cycle Assessment (S-LCA)*. Nairobi: UNEP. https://www.lifecycleinitiative.org/wpcontent/uploads/2021/12/Methodological-Sheets_2021_final.pdf.

[38] Ibid.

[39] Life Cycle Initiative, UNEP, and Social Alliance. 2020. *Guidelines for Social Life Cycle Assessment of Products and Organizations 2020*. Nairobi: UNEP. https://www.lifecycleinitiative.org/wpcontent/uploads/2021/01/Guidelines-for-Social-Life-Cycle-Assessment-of-Products-and-Organizations-2020-22.1.21sml.pdf.

[40] Franca Trubiano, "Building material supply chains and forced labor: the case of fossil fuel-based polymers," *Proceedings of the ICSA International Conference of Structures and Architecture*, Antwerp, Belgium July 2025.

[41] Amy Hawkins, "German firm BASF to pull out of Xinjiang after Uyghur abuse claims," *The Guardian*, February 9, 2024, https://www.theguardian.com/world/2024/feb/09/german-firm-basf-to-pull-out-of-xinjiang-after-uyghur-abuse-claims; Jens Fey, "BASF to divest shares in its two joint ventures in Korla, China" *BASF*, February 9th, 2024, https://www.basf.com/global/en/media/news-releases/2024/02/p-24-125 ; Keith Bradsher, "Firms With Deep Roots in China Reconsider Their Xinjiang Ties," *The New York Times*, February 18, 2024, https://www.nytimes.com/2024/02/18/business/volkswagen-basf-xinjiang-china.html; BASF, "BASF to divest shares in its two joint ventures in Korla, China", *News Release*, February 9, 2024. https://www.basf.com/us/en/who-weare/sustainability/we-produce-safely-and-eeiciently/audits/xinjiang.



3.0
Reconnaissance from the Industry

3.1 MANUFACTURER'S QUESTIONNAIRE

As the material selection process and literature review suggest, landscape materials pose a clear risk of exposure to forced labor. Determining where exactly that risk lies along the supply chains of specific products, however, is less clear. Our methodology, then, was multi-pronged. It incorporated a variety of methods to clarify the supply chains of landscape materials and identify forced labor risk along the way. We used direct and indirect routes to trace the connections from designers to products to distributors to manufacturers to raw materials, drawing on both the team's professional network and investigative data tools.

Our three major outreach approaches were:
(1) questioning manufacturers about their material sourcing,
(2) surveying designers about the products they specify and their ethical standards, and
(3) using third-party software, powered by public data, to audit the supply chains of specific companies.

Each approach had its benefits and limitations; by combining them we developed a more accurate picture of how forced labor is embedded in landscape material supply chains. This process was dynamic, continuously adapting as the team collected data and identified gaps.

3.1.1 Selection of Companies and Outreach

The manufacturer questionnaire asks company representatives how and where their products are produced. It seeks information on the supply chains of specific products, voluntarily disclosed by those who, in theory, know this information the best. We initially selected five products in each material category (permeable pavers, synthetic turf, safety surface, geotextiles, and plastic lumber) for a total of 25 products. This selection drew from the list of approved products in NYC Parks specifications, as well as products regularly specified by MNLA. Each product is produced by a distinct manufacturer. The questionnaire attempted to collect usable, specific information without being so onerous that representatives were unwilling to fill it out. Created with Qualtrics, a secure digital platform chosen to protect participants' sensitive information, the questionnaire was designed to be intuitive, easily distributed, and completed in fifteen to twenty minutes. The team emailed the selected manufacturers and asked that they fill out the questionnaire; thereafter, the team followed up twice by email and phone calls. When initial response rates were low, the team sent multiple email reminders, called the representatives, and spoke in person to those who attended landscape architecture expos (ASLA National or New Jersey ASLA).

Distribution of Questionnaire at ASLA National Expo.
To broaden our reach, the team pursued an additional tactic: in-person engagement at the American Society of Landscape Architects' National conference in Washington, DC. Two team members from MNLA attended the manufacturer expo at the conference where hundreds of landscape material manufacturers set up booths to promote their wares. No longer limiting our research to the 25 manufacturers we initially contacted, the team members spoke with 73 manufacturers across the five material categories ; 21 synthetic turf manufacturers, 14 safety surface manufacturers, 22 plastic lumber manufacturers, 12 permeable paver manufacturers, and four geotextile manufacturers. During each conversation, we discussed the research project and directed representatives to the questionnaire. See APPENDIX for the promotional postcard we deployed. Sales representatives generally expressed interest at the time, but very few have followed up by filling out the questionnaire.

During Phase 2, the team took a more local, approach at the NJASLA expo. These expos offered face-to-face conversations, but the representatives have not typically been able to answer difficult questions about labor. More targeted outreach to supply chain managers, then, was a next step.

As Phase 2 advanced and response rates remained low despite these engagement efforts, the team used additional strategies to collect relevant information. One method was asking direct questions to manufacturers via phone or email (for instance, "where is your manufacturing facility located?" and "where do you get your raw materials?"). Representatives seemed more willing to directly answer single questions such as these than to fill out a longer survey. The team has also continued to investigate material manufacturing processes and general supply chains using publicly accessible information. As a result, the team filled gaps left by the hesitance of manufacturers to fill out questionnaires by using indirect methods to obtain information covered in section 3.

3.1.2 Design of Questionnaire

The questionnaire begins with a brief explanation of the research project. It also states that all responses will be anonymized, which the team considers a necessary step to mitigate companies' potential fears about sensitive information being widely disseminated. Early questions cover general company information, such as size and location, before moving on to questions about a specific product. We ask where the product is manufactured, what raw materials constitute the product, and from where those raw materials are sourced, including supplier names and locations. Questions about product composition are tailored to each material category, meaning we created five slightly different versions of the survey (for example, one for permeable pavers, one for synthetic turf, and so on). Robust answers to questions in this section would clearly articulate the material supply chain and enable us to ask similar questions to the manufacturers' suppliers, and even their suppliers' suppliers. The final section inquires about certifications, standards, and company statements around sustainability and labor practices. These questions try to unpack companies' priorities around the issue of ethical sourcing and generate an understanding of which certifications and disclosure practices are emerging in the field.

The manufacturer's questionnaire was issued to 28 manufacturers. We use the following acronyms to categorize the companies, which remain anonymous in this report:

Material: Company Codes
PERMEABLE PAVERS: PP1, PP2, PP3, PP4, PP5, PP6
GEOTEXTILE FILTER FABRIC: GEO1, GEO2, GEO3, GEO5
SYNTHETIC TURF: ST1, ST2 (2 subsidiaries), ST3, ST4
SAFETY SURFACE: SS1, SS2, SS3, SS4, SS5, SS6, SS7
RECYCLED PLASTIC LUMBER: RPL1, RPL3, RPL4, RPL5, RPL6, RPL7

Manufacturers were selected based on a series of data points and as discussed above. The mechanisms involved for distributing the questionnaire included identifying a company representative associated with the company. MNLA was charged with keeping in contact with each representative, while the UPenn group issued the questionnaire using Qualtrics, received, and logged the data from each manufacturer. An Excel log was kept and updated of the various attempts made to contact the company representatives by MNLA, including who on the MNLA team is charged with following up with which representative.

3.1.3 Questionnaire Matrix and Responses

Matrix summarizes the information we received from manufacturers. This includes the (limited) data from questionnaire responses, supplemented by representatives' answers to the team's direct questions, and other information that companies have shared publicly.

3.1.4 Response Rate, Results, and Conclusions

The questionnaire was distributed to 28 product manufacturers over the five material categories. A total of 4 of 28 manufacturers completed the questionnaire. Summarized responses of the manufacturer questionnaire are as follows:

PERMEABLE PAVERS
PP1, PP5 & PP6 : Completed
PP2 & PP3 : Started, but not completed
PP4: No response

SYNTHETIC TURF
ST1, ST2 (2 subsidiaries), ST3, ST4: No Response

SAFETY SURFACE
SS1, SS2, SS3, SS4 & SS6: No Response, SS7: Completed
SS5 : Started, but not completed (they are not the manufacturer)

RECYCLED PLASTIC LUMBER
RPL1, RPL3, RPL4, RPL5, RPL6 & RPL7: No Response

GEOTEXTILE FILTER FABRIC
GEO1, GEO2, GEO3 & GEO5: No Response

Assessment of Risks to Rewards:
One conclusion the research group has drawn is that the risks to reward ratio is too high for the manufacturers. There are very few incentives in how the Questionnaire is written that encourage a manufacturer to complete it. They might think that this represents a high-risk activity given that it can expose them to public and research scrutiny; given that they may be revealing business connections that they've invested time and effort in cultivating; or those whom we

have asked to complete the questionnaire do not have access to the information; and lastly, in many cases it may take a great deal of time and effort to seek the person in the company who may have the answers to our questions. Regardless of these conditions, it is not tenable for companies to avoid discussing with their clients, the supply chain of the materials they sell. A great deal more effort on the part of landscape architects and affiliated professional bodies should be done to encourage these companies to discuss with their clients the origins of said products.

3.2 LANDSCAPE ARCHITECT'S SURVEY

3.2.1 Intent of Survey and Contents

The project's second survey reached designers rather than manufacturers. Its aim was to build our understanding of (1) which product manufacturers landscape architects across the country commonly specify, (2) the general priorities of landscape architects regarding ethical sourcing, and (3) what certifications these professionals use or hope to use. The survey was a simple Google Form designed to be completed in five to ten minutes.

Like the manufacturer's questionnaire, the landscape architect survey begins with a brief explanation of the project. It then collects basic information about the respondent's organization, such as the type of firm or agency and its location. The core of the survey then asks: which manufacturers do you most often specify? We include an open-ended response box for three to five manufacturers in each material category (permeable pavers, safety surface, geotextiles, synthetic turf, and plastic lumber). Collecting this information gave our research team a broader perspective on the major market players – especially outside of New York. As the names of specific manufacturers emerged and re-emerged, we sent our manufacturer questionnaires to them.

After collecting the manufacturer names, the survey's subsequent questions gauge designers' levels of awareness around where materials are produced, simply asking whether or not they know the countries of origin of the materials they specify, and what they prioritize when selecting products. We also asked about labor and environmental statements and certifications, and whether respondents have used the Design for Freedom Toolkit – a collection of resources developed by our partners.

3.2.2 Outreach and Delivery Methods

To distribute the survey, we developed an eye-catching postcard (Figure 1) with explanatory text and a link to the online form. We distributed digital versions of this via the Landscape Architecture Foundation's email newsletter and direct emails within the team's professional network. At the ASLA conference, we distributed physical postcards and engaged in conversations about the project.

During Phase 2, these efforts expanded to include the e-blasts from NJASLA and NYASLA, as well as additional postcard distribution at the NJASLA conference. MNLA also shared the postcard via the firm's Instagram page.

The charts below show a selection of results.

3.2.3 Survey Results and Conclusions

Our survey reached 21 landscape architects from across the country. It is evident that very few have considered fair labor as part of their review of building materials. This graph is the result from the second question in our 11 question long survey. It shows the priority areas of focus for material requirements when sourcing products. While fair labor is being considered by one of the respondents, all 21 focus on performance and reliability. Cost and sustainability were the second most popular responses with 16 votes each. When asked directly if labor protocols are part of the review process for material sourcing, the overwhelming majority of the respondents answered no.

Our research team is not surprised by this conclusion. It shows that the lens of labor is not in the general landscape designer's mindset at this time, even from this small sample of responses. This response tracks with the experience of the research team as we have not found the topic of labor ethics to be active in many of our main professional activities. An introduction to Design for Freedom was given at the National ASLA Conference in 2024.

Figure 3.01, Postcard created for distribution to Landscape Architects, Credit MNLA

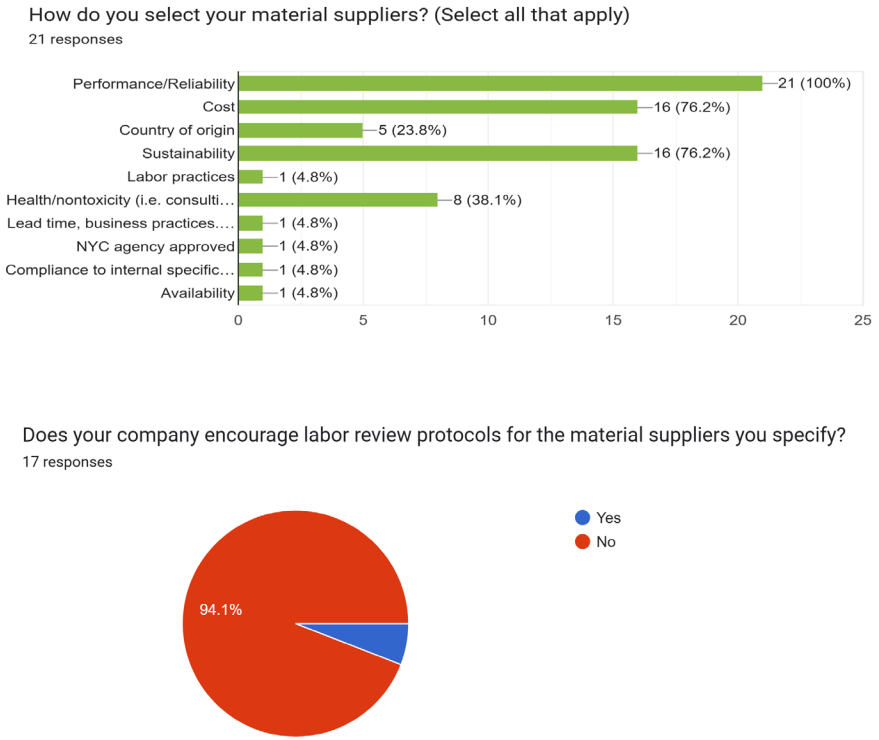


Figure 3.02, Survey Questions for Landscape Architects and Results, Credit MNLA

3.3 NEW YORK CITY FOIL REQUEST PROCESS AND RESULTS

Collaboration with NYC Parks began with a conversation with the Assistant Commissioner through which we learned about the agency's in-house sustainable initiatives including their review of Environmental Protection Declarations (EPDs) and life cycle assessments (LCAs) for specified materials. In what concerns the supply chains of materials they favor in their specifications, there is no mechanism at present for reviewing where or how the materials they purchase are made. We consulted NYC Parks' yearly updated standard specifications (Technical Specifications) which reference to NYC Parks Standard Details and preferred manufacturers. General Conditions of NYC Parks Specifications are included in the contract forms in contract book support files.

Based on the Assistant Commissioner's guidance, our team filed an information request utilizing the Freedom of Information Law (FOIL) to attain NYC Parks' yearly bid costs and purchased material quantities. In response, the agency sent all bid analysis per project for the requested fiscal years of 2018, 2019 and 2022 not including 2020 –2021 due to COVID's disruption of Park's operations during that time. We used NYC Parks' published engineer's yearly material cost estimates the previous year's bid analysis. The engineer's estimate includes, in addition to direct costs for materials, labor, shipping and handling, applicable indirect expenses by the contractor.

NYC Parks' bid evaluations and awards are based on competitive bids (lowest responsible bid price) with responsive and responsible bidders in accordance with New York City Procurement Policy Board rules, terms and conditions. These rules prohibit NYC Parks from soliciting specific materials based on their labor source. However, NYC Parks is open to considering materials based on carbon footprint and material lifecycle criteria.

Freedom of Information Law (FOIL) Requests

The Title of Documents (up to 90 Characters)	Agency	Request Description (up to 5,000 Characters)
Total built construction cost and quantity of NYCDPR standard items per fiscal year	NYC Parks and Recreations	Please provide the following information outlined below. 1. NYC Parks total construction cost of capital projects for each fiscal year : 2017, 2018, 2019, 2022 & 2023 2. NYC Parks total construction square footage (or acre) of capital projects for each fiscal year : 2017, 2018, 2019, 2022 & 2023 3. Each NYC DPR standard item's cost and quantity for each fiscal year: 2017, 2018, 2019, 2022 & 2023 Item #1 ALL BENCH TYPES WITH RPL SLATS and ANY CONSTRUCTION USED RPL: Total construction cost, total linear feet and total square feet (RPL deck) Item #2 SAFTY SURFACING, ALL COLORS, ALL DROP HEIGHT: Total construction cost and total square feet Item #3 SYNTHETIC TURF, ALL TYPES : Total construction cost and total square feet Item #4 GEOTEXTILE, ALL TYPES: Total construction cost and total square yard

Figure 3.03, FOIL Request, Credit MNLA

Material Products, subject of the NYC FOIL Request

Article 6 of the New York State Public Officers Law is known as the Freedom of Information Law (FOIL). Once the FOIL request is filed, a requester will receive within five business days a confirmation letter. The response from the Agency will take up to 20 business days from the date of the acknowledgment letter. Due to the anticipated waiting period, MNLA filed a FOIL request with the NYC Parks and Recreation on May 8th prior to the commencement of the grant.
The requested information included the quantity (e.g., square feet/per year), see Appendix B, and cost of the five identified material products (permeable pavers, geotextiles, synthetic turf, safety surface, recycled plastic lumber) installed in capital projects to evaluate how much of each material NYC Parks procures.

Investigated five materials in procured NYC Parks capital projects

- Total of procured NYC Parks capital projects
- Bid prices were examined for the fiscal year of 2018, 2019 and 2022 (Research team intentionally avoided the year of 2020 and 2021 due to COVID)
- Overall analysis: Before COVID, all of the investigated five (5) materials can be found in more than 60% of bid projects. Post COVID, findings dropped to under 50%.
- Although the total bid cost of investigated materials in 2022 is twice that of pre-COVID year 2019.
- Among the investigated materials, synthetic turf and safety surface are highest of total bid cost. Synthetic turf is bid typically in high quantities, whereas safety surface is approximately three to four times the unit cost of synthetic turf.
- Total bid price of the investigated five materials per fiscal year examined is under 10%.
- A review of the investigating materials' total cost reveals synthetic turf and safety surface materials account for up to 60% of the total expenditures of the five investigated materials.

3.4 RISK IN THE US: CONSTRUCTION SITES IN NEW YORK

Forced labor is also a reality in the United States, where individuals are working against their will or in conditions tantamount to forced labor. Whether this is happening on construction sites involved in landscape projects is likely, as it is not difficult to recognize the factors which contribute to forced labor in the industry.[1]

Amongst the conditions which contribute to an increased risk for forced labor, is an individual's legal status. Without the legal protection of citizenship or that of a work permit, those who labor for others are more likely to be abused or ill-treated because of the limited likelihood that they will report or denounce their abuser. Concerned with being reported to authorities, those who are subjected to poor working conditions rarely complain. Moreover, individuals without legal protection, are often day laborers who work without contracts, and without the promise of steady employment, regardless of whether they are skilled or not. Many highly skilled masons, painters, and landscapers are required to work as day laborers, because they do not have work permits.

Immigrant day laborers on construction sites are common, particularly in smaller scale, residential construction projects and landscaping projects.[2] Given the episodic nature of building projects, construction contractors, sub-contractors, and clients, often seek this kind of help for limited tasks. Typically, immigrant laborers hired for a day's work have the least protections amongst construction workers. Without the protection of a union, they are at the mercy of lowest bidders and individuals who often know very little about the men and women they pick up alongside the road or in the parking lot of a Home Depot or Lowes.

This does not mean, however, that day-laborers are without rights. All day-laborers in the United States are protected by the Fair Labor Standards Act (FLSA), that sets a minimum wage, working hours, and protection against injury.[3] Whether these laws are respected or enforced is another issue all together.

In the City of New York, serious labor violations are reported and communicated publicly. The "Employer Violations Dashboard" for example is a resource that allows the public to investigate whether any company that does business with the city has had violations levied against it. Managed by the New York City Comptroller, the Dashboard is described as the place where those who work in NYC:

> "*are protected against workplace exploitation by local, state, and federal laws. Too often, employers skirt those laws by exposing workers to unsafe conditions, by committing wage theft, through discrimination, or by engaging in illegal anti-union activity. The Comptroller's Office is a municipal agency tasked with enforcing prevailing and living wage laws in New York City. The office also endeavors to protect workers' rights through legislative, policy, procurement, and corporate shareholder engagement initiatives.*"[4]

The website is interactive and searchable.

With regards to Workplace Safety, Construction is a Sector that can be searched in the database. In 2024, for example, amongst the "Severe OSHA Violations, New York City Worksites," there were 10 violations of either a Willful or Serious nature, of which 9 resulted in Fatalities, and all of which had no Union on site. The deaths resulted from falls from heights, roofs, and scaffolds. In 2023, there were 12 Construction related violations of which 11 resulted in death and all had no Union on site.[5]

In addition, the NYC Department of Buildings (DOB) "*investigates and brings charges against property owners and contractors who violate these laws... before the Office of Administrative Trials and Hearings ("OATH"), where judges determine whether these laws were violated.*"[6] In this category of "NYC Department of Buildings OATH Violations Related to Construction Safety" more than two dozen companies were fined for offenses such as "failure to safeguard persons/property affected by construction"; "failure to comply with manufacturer specifications"; "construction superintendent failed to perform duties per code"; "permit holder failed to ensure workers receive site safety orientation."

NYC also maintains company specific data for Wage Theft, Unfair Labor Practices, Discrimination & Harassment, and Prevailing Wage. A particularly insightful category is that of the "Employer Wall of Shame," where stories such as this are common:

> "*Timeless Roofing is a construction company, with back-to-back willful Occupational Safety and Health Administration ("OSHA") violations in 2023 and 2022 for its failure to provide fall protection. Willful violations are the most severe type of OSHA violations and are defined as "a violation in which the employer either knowingly failed to comply with a legal requirement (purposeful disregard) or acted with plain indifference to employee safety.*"[7]

Information and data about risky labor practices on US construction sites is also maintained and searchable by OSHA, the US Department of Labor, Occupational Safety and Health Administration.[8] The State of New York, Department of Labor also maintains publicly accessible data for Wage Theft,[9] as well as the Construction Industry Fatality Registry.[10]

Endnotes

[1] Michelle Arevalos Franco, "Invisible Labor: Precarity, Ethnic Division, and Transformative Representation in Landscape Architecture Work," *Landscape Journal: design, planning, and management of the land*, Volume 41, Number 1, 2022, pp. 95-111.

[2]Natalia Siniavskaia, "Immigrant Workers in the Construction Labor Force," Special Studies, NAHB Economics and Housing Policy Group, March 3, 2020. https://www.nahb.org/-/media/NAHB/news-and-economics/docs/housing-economics-plus/special-studies/2020/special-study-immigrant-workers-in-the-construction-labor-force-march-2020.pdf

[3]Lisa Burden, J.D., Legally reviewed by Aviana Cooper, Esq., "Fair Labor Standards Act: Laws for Minimum Wage, Working Hours, and Other Protections," April 14, 2025, https://www.findlaw.com/employment/wages-and-benefits/fair-labor-standards-act.html ; see also Robert Diliberto, "Understanding the rights of day laborers", April 23, 2020, Construction Law, https://www.getrjd.com/blog/2020/04/understanding-the-rights-of-day-laborers/

[4] NYC Comptroller, Employer Violations Dashboard, https://comptroller.nyc.gov/services/for-the-public/employer-violations-dashboard/about-the-dashboard/

[5] Ibid

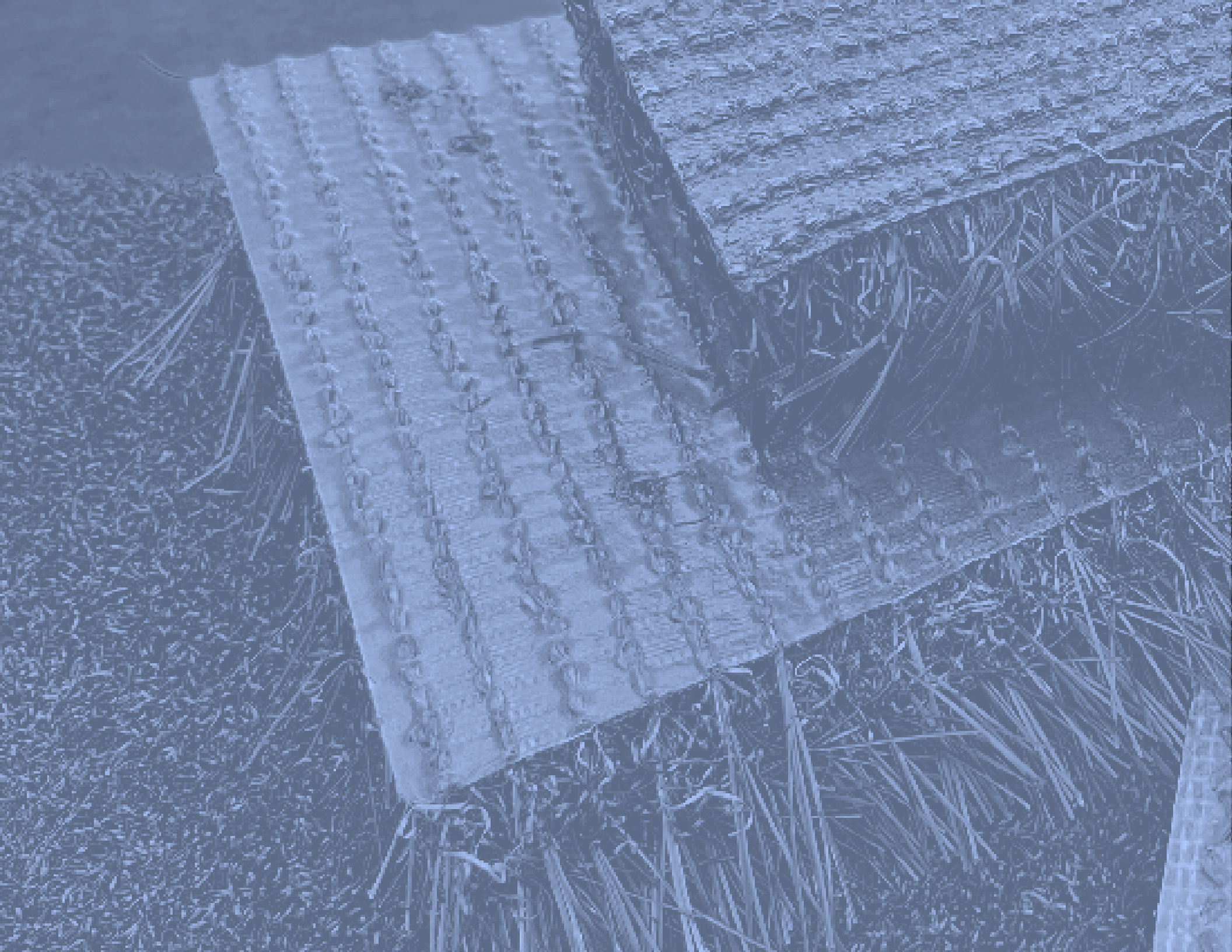
[6] Ibid

[7]https://comptroller.nyc.gov/services/for-the-public/employer-violations-dashboard/employer-wall-of-shame/#_ftn27

[8]https://www.osha.gov/ords/imis/establishment.violation_detail?id=1585981.015&citation_id=01001

[9] https://dol.ny.gov/wage-theft-dashboard

[10] https://dol.ny.gov/construction-industry-fatality-registryB



4.0
Third Party Verification of Supply Chain Audits using Sayari

4.0 | Third Party Verification of Supply Chain Audits Using Sayari

4.1 Sayari Online Platform of Supply Chain Audits

Starting in July 2024, UPenn began a working relationship with an on-line company that offers open-source data related to supply chain mapping. This was not one of the companies originally reviewed by COOKFOX, yet we identified it as a leader in the space given its commitment to both supporting industry and business as well as independent researchers. Like other companies in this space, Sayari collects, gathers, and organizes shipping information between companies, information about corporate governance, as well as any recorded citations or risks directly associated with forced labor, money laundering, and other forms of illicit activity between companies.

They identify themselves as:

> "*Sayari is the Counterparty and Supply Chain Risk Intelligence Provider built to provide worldwide visibility into the relationships between businesses and individuals*." https://sayari.com

By October 2024, we were given access to the Sayari Graph portal which allowed us to investigative the potential risk of forced labor within the supply chains of the companies we identified. We've attended multiple webinars to more fully understand how the platform operates, and we have received two one-on-one tutorials from the group. This outfit is incredibly responsive to researchers and should be lauded for their openness and availability.

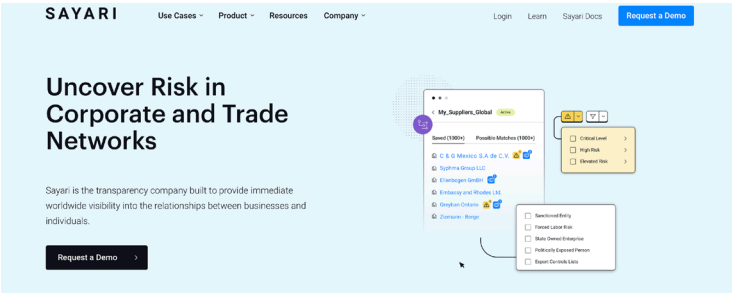


Figure 4.01, Sample image from the Sayari website

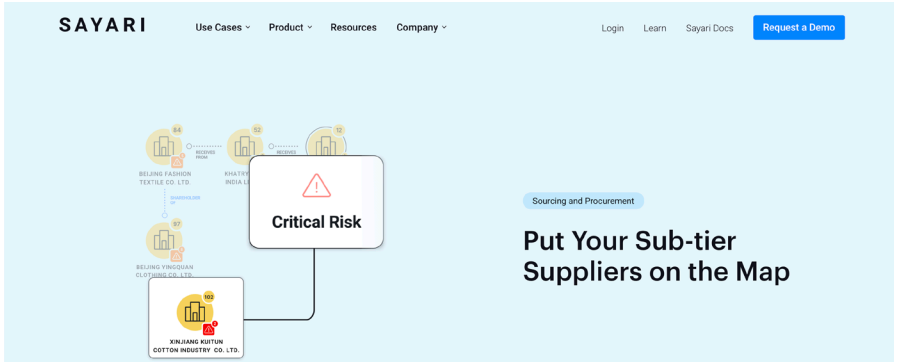


Figure 4.02, Sample image from the Sayari website

In collaboration with Phil Kittock _ Lead Analytical Content manager and Debora Almeida _ Senior Content Manager from Sayari, we were able to investigate the various multi-tier supply chains of our landscape material companies.

What is Sayari and what does it offer?

For investigating our selected companies, we employed the data collection and risk assessment capacity of Sayari, a leading voice in the space of supply chain analysis.[1] Self-identified as a "*transparency company providing visibility into complex commercial relationships*" its clients include corporate giants J.P. Morgan, HSBC, Urban Outfitters, Facebook, and the US Departments of Commerce and Treasury. For these clients and others, they "*connect key relationships between businesses and individuals, helping investigative teams navigate critical, obscure ties.*"[2]

Sayari is an online tool that can help us when investigating environmental and human rights abuses of corporate entities. In this way, Sayari promotes their ability to "*uncover risk in corporate and trade networks*." It helps companies attain a higher degree of transparency with regards to their global supply chains. They offer online training that helps companies acquire access to all their databases, particularly for companies who are interested in undertaking due diligence in their supply chains for E.S.G. accountability.

Sayari's graphically robust visualization software depicts corporate entanglements behind the global transportation of products from point A to point B. Using HS codes (the international standard of names and numbers used to classify traded products) associated with shipping documents such as commercial invoices, bills of lading, air waybills, packing lists, certificates of origin, and custom declarations, Sayari helps map a company's supply chain.

It collates information associated with forty different business risks. It scours sources for adverse media, official government registries, litigation filings, and ownership data from hundreds of jurisdictions and sources to identify a company's possible involvement in organized crime, deforestation, illegal or restricted trade to entities with military end users, money laundering, and forced labor. Cybercrime, law enforcement action, bribery and corruption, evidence of forced labor, and being on export controls lists or sanctioned by a national government are also risks.

Using Sayari, our team reviewed the Forced Labor risk profiles of 34 companies that supply the US market with synthetic turf (ST), safety surface (SS), geotextiles (GEO), recycled plastic lumber (RPL), and permeable pavers (PP). A clear majority of the companies analyzed have clear evidence of forced labor in their supply chains. Many had risks buried within their second and third tiers of production, others were themselves directly at risk for forced labor.

How does Sayari collect its data and how is the data organized ?

The data is collected through various open-source portals that include company registrations in their home countries, available bills of lading produced every time a product is shipped from one part of the world to another and enters and leaves a port, academic reports that identify companies, adverse media, legal judgments, global sanctions and watchlists. Sayari claims to have access to 8 billion corporate disclosure documents collected through their various open-source channels.

The data is organized and evaluated according to criteria that establishes sourcing and procurement patterns, global trade networks, the potential for financial crime, law-enforcement and regulatory actions, defense and intelligence, and sanctions. As noted, the main categories of risk are Adverse Media, Environmental Risk, Export Controls, Political Exposure, Regulatory Action, Sanctions, Sanctions and Export Control Lists, and most important for our work, Forced Labor. In each of these categories, the software identifies Elevated, High, and Critical Risks associated with each of the companies. These are the same designations that were used in our evaluation of the various sample companies in the report.

For example, in the data related to **Adverse Media**, the data seeks entities that have been mentioned by "*official government websites or mass media outlets as wanted, charged, indicted, prosecuted, convicted, or sentenced for criminal activity related to bribery and corruption, cybercrimes, financial crimes, law enforcement action, organized crime, reputational risk, terrorism.*"[3] Of most interest to us was the mention of "*official government websites or mass media outlets as wanted, charged, indicted, prosecuted, convicted, or sentenced for criminal activity related to forced labor and modern slavery.*"[4]

In the data related to **Environmental Risk**, the data seeks entities that "*export cattle or cattle products, cocoa, coffee, palm oil, rubber, soya, wood, from one or more countries where its production* may *be associated with high risk ...* [with] *commodity-driven deforestation, biodiversity loss, and governance.*"[5]

In the data related to **Export Controls,** they seek entities that "*may have directly exported to Russia, Belarus, or Iran one or more shipments*"; "*display an active license from the Federal Security Service of the Russian Federation (FSB RF), which allows companies to work on projects classified as a state secret*"; that are "*subject to trade restrictions per the U.S. Consolidated Screening List, a list of parties for which the United States government maintains restrictions on certain exports, reexports, or transfers of items*";[6] amongst another two dozen export controls.

In the data related to **Sanctions,** which has the highest number of risk categories, they seek entities that "*may be controlled by a sanctioned party designated via the Australia Consolidated Sanctions List*"; "*may be controlled by a sanctioned party designated under the OFAC SDN Foreign Persons Involved in the Global Illicit Drug Trade program*"; "*may be controlled by a sanctioned party designated via the UK Consolidated Sanctions List*"; "*may have exported to an entity that is currently subject to trade, transport, immigration, and/or financial sanctions in one or several international sanctions lists*"; that "*exports to an entity that has been added to the EBRD Ineligible Entities List*";[7] and many more.

There are dozens of different categories associated with **Forced Labor** across the full spectrum of Elevated, High, and Critical risks.

How is the data communicated?

- Once the data is collected, it is communicated via four separate tools: Sayari Graph, Map, Signal and Guide. These four portals use graphic representations, Excel spreadsheets, and downloadable reports to distribute the information. Sayari Graph is a visual interface that connects companies and their officers to each other using bubble diagrams and vectors.

The companies that supply materials to other companies, are identified according to their tier in the supply chain. With these graphs we can identify the flow of materials between companies, but equally the level of risk associated with each company.

- Sayari Map is equally helpful in visualizing the information; however, it is less graphically intense and articulate than Sayari Graph.
- For this project, our team mostly used Sayari Graph for visualizing the relationships between the various companies as well as reports which are generated by Sayari that summarize their risk level.

How did we use the data, and did we see changes over time?

- The information collected was evaluated for risk to 34 companies. This number includes 6 companies in addition to the 28 companies who received the Manufacturer's Questionnaire. We conducted this analysis over fourteen months starting in late summer 2024 and concluding in the fall of 2025. We did see significant changes for some of the companies involved. In some cases, companies increased their risk over the year while in other cases, companies decreased their risk. Sayari updates their data regularly, and it is the case that companies will change their risk, based on new information added to the data analysis. If, for example, a company introduces an intermediary or additional tier, between their product and their suppliers, it is possible that this company reduces their risk because now they are more than three supplier tiers away from a company with forced labor in their supply chain.

Are there difficulties using Sayari? Yes, difficulties exist when for example:

- A company's footprint is too small to measure. With insufficient trade data to analyze, no evaluation can be made of a particular company using Sayari, particularly if supplier information is not available. Where companies are identified with a gray Forced Labor Risk), this signals insufficient information for us to review regarding their trade patterns in Sayari. Typically, this would mean that they either don't transport materials using ships or their associated/ affiliated companies are not identifiable in Sayari as related to our company.
- Additionally, difficulties can arise if companies have too large of a footprint in Sayari trade data. In several cases, companies are extremely large entities with affiliated sub-companies and subsidiaries. In these cases, it is difficult to identify which of the affiliated companies are related to our exact product with three to four hundred thousand trading documents.
- There are also difficulties associated with a lack of transparency in the process of buying and selling products. There are dark spots in the data, notwithstanding the availability of open-source data collection.
    1. For example, if material products are moving in and out of economic free zones, these geographically designated areas within a particular country, sometimes have different rules for tariffs, taxes, and trade. In this way, it is harder to trace the materials and products that are coming in and out of these zones. These free trade zones are found throughout the world, and most acutely in Asia, Gulf States and Africa.
    2. In addition, when products are transported over ground and cross land borders, there are no records that are kept or made available. This is the case when products are transported in European countries and across certain Asian borders, no bills of lading are made available. In this way, we don't know if products are being transported from Spain to Poland or from Cambodia to Vietnam. The same is true for materials and products transported by air.
    3. Difficulties also arise when bills of lading are not filled out appropriately and basic information is left blank. This is often the case when Sayari claims "unknown" in its data entry.
    4. And lastly, as with any system predicated on data collection, and its organization, there is the potential for inadvertent data corruption.
- Lastly, while information regarding second and third companies is available for any one of the companies analyzed, it is not necessarily the case that the goods from second and third tier suppliers are the same goods that make their way downstream to these companies. It is highly likely that this is the case, but not definition.

Endnotes

[1] Franca Trubiano, Noriko Maeda, and Ivanna Dudych, "Covering Ground: Identifying the Risk of Forced Labor in Five of the Most Specified Landscape Architecture Materials in the US", *Proceedings of the ICSA International Conference of Structures and Architecture*, Antwerp, Belgium July 2025.

[2] Sayari, https://sayari.com

[3] This is from an Excel list of Risks supplied by Sayari.

[4] This is from an Excel list of Risks supplied by Sayari.

[5] This is from an Excel list of Risks supplied by Sayari.

[6] This is from an Excel list of Risks supplied by Sayari.

[7] This is from an Excel list of Risks supplied by Sayari.

4.2 EVALUATING RISK IN SUPPLY CHAINS USING SAYARI

The material narratives discussed in Section 4.3, conclude with a report on the Sayari investigations into forced labor risks for each tier in the supply chains of the 34 companies we investigated on this platform. Sayari reports on many other business risks, but we chose to focus exclusively on their reporting of "forced labor."

The Sayari data has allowed us to develop two different risk profiles:

1. Sayari Graph RISK Profile for all (34) companies, which offers a direct summary of the data exported using Sayari graph for all reported tiers in a company's supply chain.
2. EVALUATED RISK Assessment for all (34) companies, made by our research team, and based on the Sayari Graph RISK Profile.

4.2.1 Sayari Graph RISK Profile

Sayari's data base identifies the Forced Labor Risk for companies with associated risks. They attribute to each company markers in the shape of triangles. The triangles are given a color depending on whether the risk is Elevated, High, or Critical.


Elevated Risk (Yellow)


High Risk (Orange)


Critical (Red)

Thereafter, Sayari identifies the number of times the company has been identified with a forced labor risk. As shown below, the triangles are labeled with numbers from 1 to 16 (and greater, if this applies).

In the above example, this company notation means it has a High Risk (Orange) with 7 instances of forced labor risk factors in the Sayari data base.

The number of forced labor identified instances doesn't necessarily correlate to the level of risk Sayari attributes to the company. On Sayari's platform, companies can have an Elevated (Yellow) triangle with 13 identifications of forced labor, while others can have a Critical (Red) triangle with 2 identifications.

A Sayari Graph RISK Profile was conducted for 34 companies: the summaries of which are included in the respective Material Narrative sections. In addition, we communicate detailed graphic narratives for more than 50% of our companies having produced (18) detailed Diagrams of Supply Chains and (9) Shipping Maps of Global Supply Chain Risk for the following companies. (The Diagrams and Maps are in their respective material narratives in section 5.0).

Diagrams of Supply Chains

- Permeable Pavers: PP1, PP2, PP5, PP4, and PP7
- Geotextiles: GEO1, GEO3 and GEO5
- Synthetic Turf: ST1, ST2, ST4, ST5, ST7, ST8
- Safety Surface: SS1 and SS4
- Recycled Plastic Lumber: RPL1 and RPL7

Shipping Map of Global Supply Chain Risk

- Permeable Pavers: PP1 and PP5
- Geotextiles: GEO1 and GEO3
- Synthetic Turf: ST1 and ST7
- Safety Surface: SS4
- Recycled Plastic Lumber: RPL1 and RPL7

4.2.2 EVALUATED RISK Assessment

Based on the Sayari Graph RISK Profile that we created for each of the 34 companies we studied, we produced a risk assessment which evaluates the risk level posed by each company. Based on where in the supply chain forced labor risk triangles were identified—within the said company, or along one of its tiers—all 34 companies were assessed on a scale from (highest risk) dark red to (no risk) dark green: from "Clear Evidence of Forced Labor Risk" to "No Forced Labor Risk." Detailed descriptions of each level are offered below.
In summary, the Forced Labor Risk Level for each company was designated according to this scale.

Clear Evidence of Forced Labor Risk

If the company in question was identified by Sayari as having immediate, direct risk of forced labor because Sayari attributed to it an Elevated, High, or Critical triangle, this company was identified by us as being a Clear Evidence of Forced Labor Risk company. All companies we investigated that had immediate risk of forced labor were in the Elevated Risk category.

- 10 companies had Clear Evidence of Forced Labor Risk

First Tier Forced Labor Risk

If the company in question was not identified by Sayari as having immediate, direct risk of forced labor, yet it was identified by Sayari as having in one or more of its first-tier suppliers a direct risk of forced labor in the Elevated, High, or Critical range, we identified this company as a First Tier Forced Labor Risk company.

- 8 companies had First Tier Forced Labor Risk

Second Tier Forced Labor Risk

If the company in question was not identified by Sayari as having immediate, direct risk of forced labor, yet it was identified by Sayari as having in one or more of its second-tier suppliers a direct risk of forced labor in the Elevated, High, or Critical range, we identified this company as a Second Tier Forced Labor Risk company.

- 5 companies had Second Tier Forced Labor Risk

Third Tier Forced Labor Risk

If the company in question was not identified by Sayari as having immediate, direct risk of forced labor, yet it was identified by Sayari as having in one or more of its third -tier suppliers a direct risk of forced labor in the Elevated, High, or Critical range, we identified this company as a Third Tier Forced Labor Risk company.

- 2 companies had Third Tier Forced Labor Risk

Possibly No Forced Labor Risk

If the company in question was not identified by Sayari as having immediate, direct risk of forced labor, and it was identified by Sayari as not having a direct risk of forced labor in the Elevated, High, or Critical range in any of the top three-tier suppliers, we identified this company as a Possibly No Forced Labor Risk company.

- 1 company had Possibly No Forced Labor Risk

No Forced Labor Risk

If the company in question was not identified by Sayari as having immediate, direct risk of forced labor, identified by Sayari as not having a direct risk of forced labor in the Elevated, High, or Critical range in any of the top three-tier suppliers, and it demonstrated third party Certification to this effect, we identified this company as a No Forced Labor Risk company.

- 0 companies had No Forced Labor Risk

Insufficient Information to Evaluate

If the company in question was identified by Sayari as not having sufficient data, we identified this company as Insufficient Information to Evaluate.

- 10 companies had Insufficient Information to Evaluate

4.2.3 Plot of Forced Labor Risk

To visualize the full array of risks associated with our 34 companies, we plotted their Evaluated Forced Labor risk level along the scale, for each of the 5 material categories and for each company identified in each material category. (see Plot of Forced Labor Risk Levels - figure 4.01)
NB. One company (PP1) had three different subsidiaries with three different ratings. This is why there are 36 assessments in this summary and on the Plot of Forced Labor Risk Levels.

Moreover, eliminating the 10 companies for which we have insufficient data in Sayari, the remainder of the companies we mapped (26) offer the following percentages of forced labor risk:

Clear Evidence of Forced Labor Risk	38%
First Tier Forced Labor Risk	31%
Second Tier Forced Labor Risk	19%
Third Tier Forced Labor Risk	8%
Possibly No Forced Labor Risk	4%
No Forced Labor Risk	0%

Plot of Evaluated Forced Labor Risk levels for all 34* companies, as assessed by MNLA/Trubiano

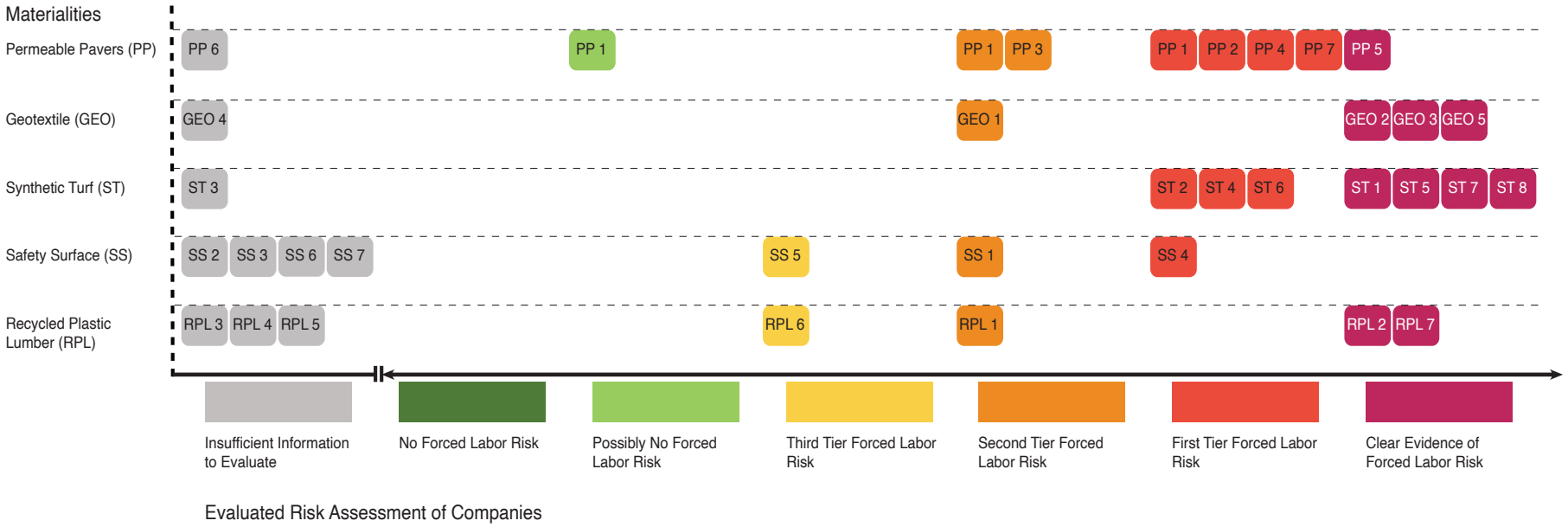
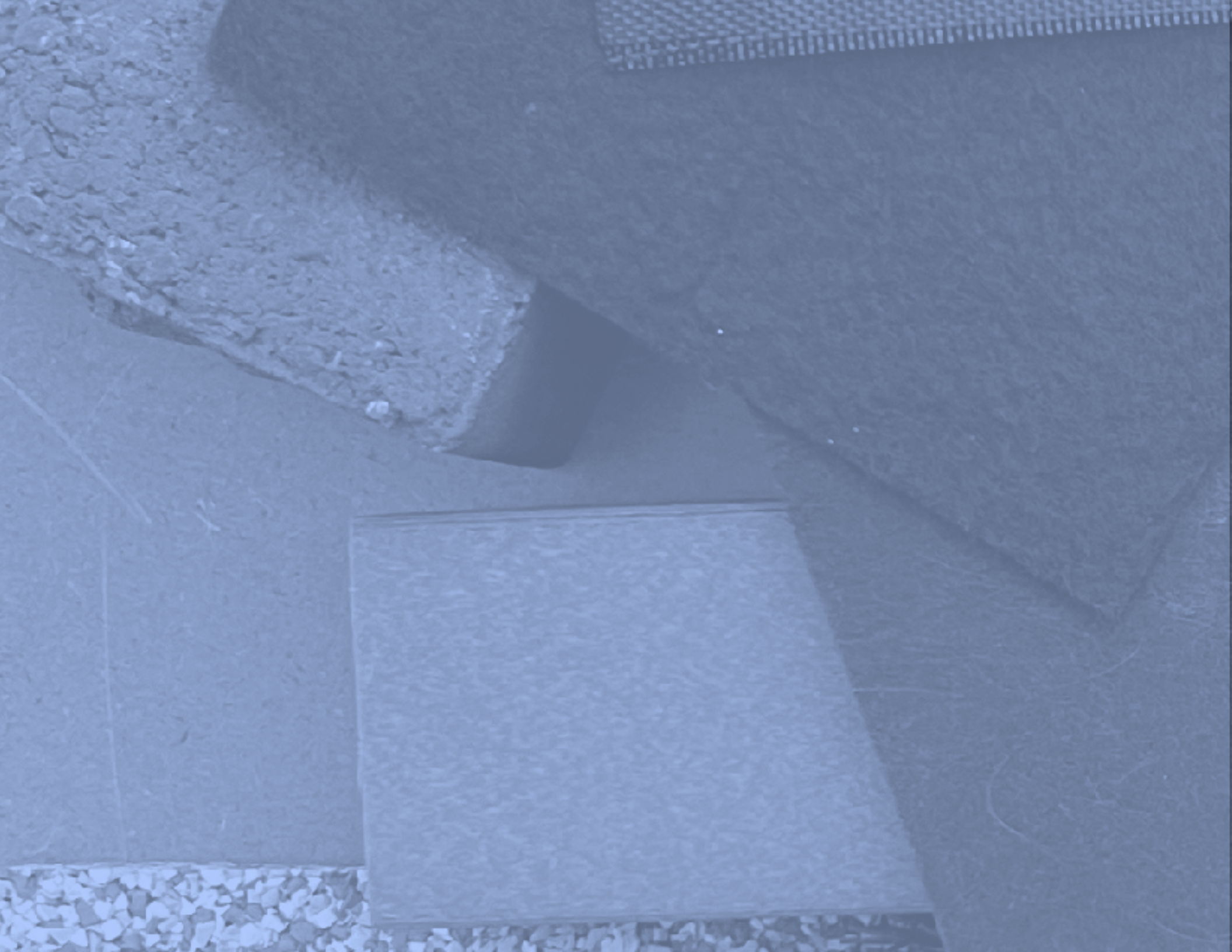


figure 4.03, Plot of Evaluated Forced Labor Risk Levels for 34 Companies, Credit Ivanna Dudych*

** (One company, PP1, includes two subsidiaries bringing the sum below to 36. See Section 5.1.)*



5.0 Materials and Their Narratives

5.0 MATERIALS AND THEIR NARRATIVES

Over the course of this research project, our team investigated the following five much used and specified landscape construction materials: permeable pavers (PP), geotextiles (GEO), synthetic turf (ST), safety surface (SS) and recycled plastic lumber (RPL). These were selected for their frequent use in landscape architecture, their diversity in material type, and to contribute new material research to the growing body of research in the material supply chains of architectural materials.

In general, we chose permeable pavers because they are predominantly cementitious in their raw materials. They are typically made of sand and stone (gravel and limestone) materials and cited as at-risk materials by the United States Department of Labor. Many precast concrete members however, also use polymers and resins as additives to increase the plasticizing capacity of the mix. In this way, it increases their risk of forced labor as derived from the petrochemical industry. We chose geotextiles to begin our narrative on polymers, because geotextiles are the foundation of all landscapes. They are essential for the drainage and structural support of earth works, and as such are found in many other assemblies discussed in this report. Synthetic turf is a material that is very common in the design of playgrounds and sports fields. Made to resemble grass, it is advertised as an effective substitute for the real thing because it requires less maintenance and water. However, synthetic turf has proven to be one of the most contentious materials in the building industry. Synthetic turf is an all-polymer material which derives all its material processing from petrochemicals. Safety surface is a material product typically used in playgrounds for young children to support active play and to cushion their falls from heights. Previously known as a mostly rubber product, safety surface is being produced today using various polymer and non-polymer materials. Lastly, we reviewed the use of recycled plastic lumber given that several companies are interested in promoting the recycled claims of this otherwise all-wood product. Claims of recycled content are incredibly difficult to verify, however, and in some instance falling short of intended goals.

Each material product is unique, but four of our five case studies share a connection to the extraction and processing of petrochemicals. Transforming oil and gas into plastic is a complex process. Unlike natural materials such as wood, the connection between a finished plastic product and its raw material is not intuitive. To achieve this transformation – and then realize its associated profits – plastic manufacturers require significant inputs of energy and human labor. Understanding the basics of petrochemical manufacturing, is an important first step to lifting the veil on forced labor risk in synthetic products.

For each material type we define what the product is, how it is used, identify its role in landscape architecture, and in some instances address how extensively it is used by NYC Parks. Additionally, each material narrative discusses its material composition, manufacturing, raw materials, reviewing differences across multiple companies. Each narrative also communicates manufacturer engagement and data access challenges, identifying how many different companies we investigated, and whether they chose to participate in the Questionnaire. We engaged a minimum of 5 and a maximum of 8 manufactures per material product, both directly and indirectly. We also report on how each company voluntarily advertised their labor ethics and how they positioned themselves relative to Environmental and Health Product Declarations. We identified their CSR, Corporate Social Responsibility positions, where they existed. We reviewed whether the material has been the subject of noteworthy press and lastly, we assessed the forced labor risk of each of the 34 companies that we examined in Sayari, by way of an evaluation matrix devised by our team.

In general, all material categories associated with landscape architecture are at risk of identifying force labor in their supply chains. The evidence is conclusive for more than 50% of the companies investigated in any one material category of our study, and in some categories the risk is as high as 80%. As expected, most risk is identified in the data associated with companies who source any component of their raw materials or equipment from already identified high risk areas in China, Vietnam and India.

5.1
Permeable Paver

Edward W. Kane Park, Philadelphia Pennsyvalnia Credit Elizabeth Felicella

PERMEABLE PAVER DETAIL

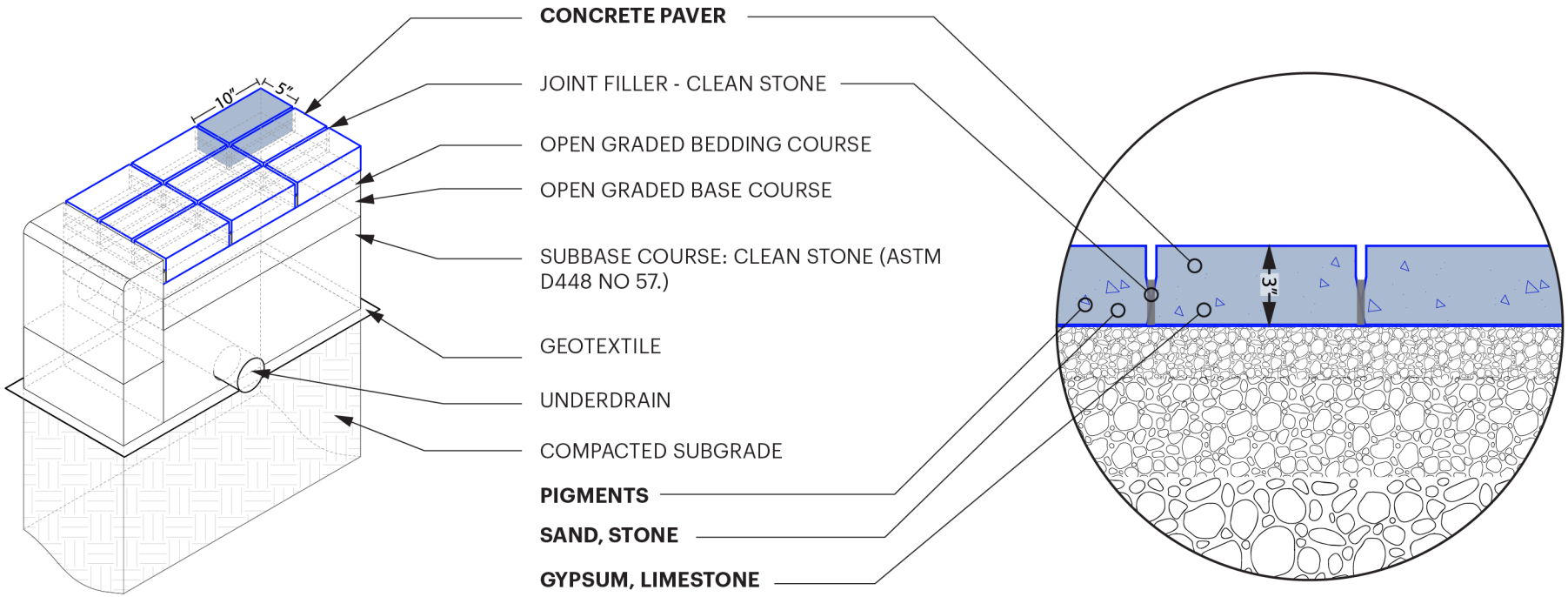


Figure 5.01, Permeable Paver Detail, Credit MNLA

5.1 PERMEABLE PAVER

What are Permeable Pavers and why are they used?

Permeable pavers are a sustainable hardscape option allowing stormwater to permeate into the groundwater directly below the installation, rather than sheeting into a location beyond the surface. Different from regular pavers, the joint between the pavers is not made of a hardened or cured mortar, but rather of a porous compound that facilitates water penetration.

Permeable pavers are typically used in a variety of different hardscape applications across NYC. NYC Parks incorporates permeable pavers in streetscapes, park and playground pathways, plazas, waterfronts, and esplanades. It is assumed that permeable pavers provide some amount of stormwater management throughout their lifespan. For this reason, many landscape architects as well as those at NYC Parks view permeable pavers as a preferable hardscape option to promote re-hydration of the water table and to diminish the risk of compromising the watershed downstream.

NYC Parks and NYCDOT have, however, had concerns with the reliability of permeable pavers for the long-term management of stormwater. The joints between pavers through which the water is expected to flow can clog, and the

Figure 5.02, Permeable Paver Joints, Credit MNLA

arduous maintenance required to ensure they remain permeable is seldom undertaken during the project's lifespan. As of now, it is not clear how long it takes for these joints to become fully clogged. Moreover, permeable pavers should not be used where there is a high degree of pollutants on the ground plane as the water is meant to flow through them to the ground water table below, possibly carrying and transmitting pollutants into the water table.

Material Composition and Manufacturing

Our team studied a series of permeable paver assemblies specified by NYC Parks for investigating where the risk of forced labor might occur across the supply chain of its various components.

The cross-section installation includes:

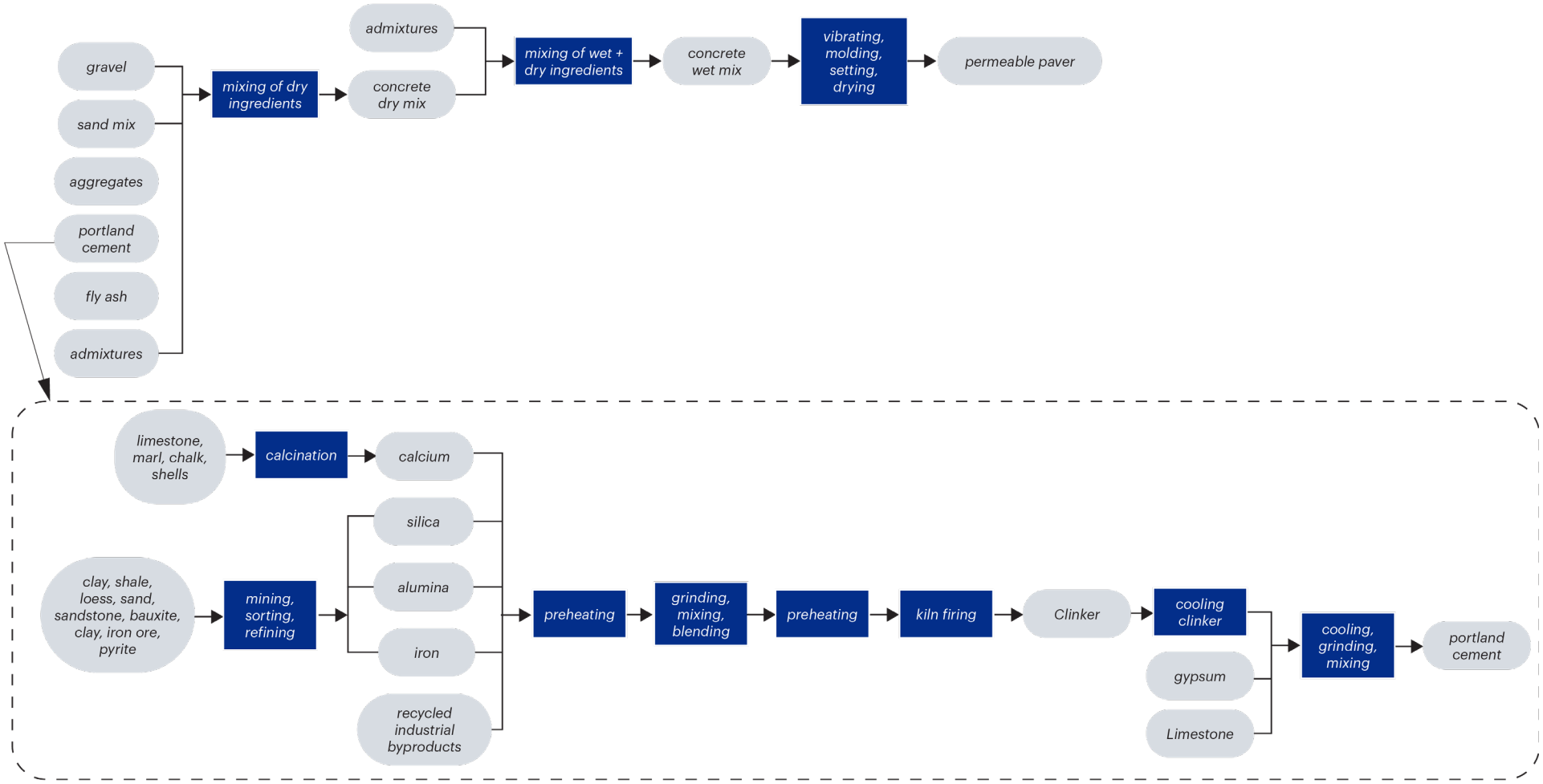
- Concrete paver
- Bedding course of fine, clean stone (1/4"-3/8"),
- Base course of slightly larger aggregate (3/4"-1")
- Sub-base course of clean stone (2.5"-3").
- A perforated PVC pipe is optional at the bottom of the base course, above a layer of geotextile
- A joint filler of clean stone is used between the pavers to allow the water to flow through.

Typically, the concrete paver (from manufacturers investigated in this study) is 3" deep and ranges in size from 4"x 8" to 12"x18" The material ingredients used in the making of concrete pavers will differ based on the chosen aggregate type and pigments. For this study, we have chosen to explore a standard concrete mix as described in the EPD issued by company PP1; the main components of which are sand, (stone) gravel, (stone) aggregates, Portland Cement, and admixtures.

When considering the origin of raw materials for concrete pavers, it is highly probable that the sand, gravel, and aggregates are sourced locally (given the high cost of importing such heavy materials). Portland Cement and concrete admixtures can, however, be sourced from across the world. Admixtures, for example, that are typically used in the making of precast concrete curbs and tiles are not minor ingredients. The concrete mix for PP1, for example, identifies the use 0.1% of its weight for the admixture, which is a plasticizer meant to improve the concrete's flexibility and durability.

The flow of water between pavers occurs through loose gravel or specialized joint mortar. One manufacturer we studied, PP6, uses different chemical coatings for the grains of sand used in the mortar joint. They also use chemical coatings for the bedding course of fine clean stone immediately below the concrete paver. When coated, the sand chemically sets in place while allowing water to pass through the void spaces between sand particulates in the joint. Many coatings from this company are resin-based, with ingredients that include chemicals such as Naphtha and Ethylhexanoic acid.[1] One of their

PERMEABLE PAVER MATERIAL PROCESS DIAGRAM



Sample mapping of concrete permeable paver manufacturing process

New graphic based on content from:

ACA: Cement Association of America: www.cement.org

Environmental Protection Declaration from Case Study PP1

Figure 5.03, Permeable Paver Material Process Diagram, Credit MNLA

coatings uses virgin rubber as a key ingredient, for introducing flexibility in the joint.

Beneath the concrete paver are a series of drainage layers of crushed stone. Thereafter, the assembly includes a geotextile layer and an optional perforated PVC pipe at the lowest point in the section. (See section 4.2.2 of this report for a comprehensive statement on the purpose of Geotextiles.) When using a geotextile, this allows the water to travel below the concrete paver joints, between layers of different-sized aggregates of subgrade, without the layers of aggregate mixing and settling as the water flows through the system. Geotextiles are critical to the ultimate success of such hardscapes as they prevent water from pooling under the concrete pavers in areas where fine silt from a topsoil layer has settled into the spaces within the larger aggregate stones. Without the geotextile, this would result in an impermeable subgrade. To further reduce the risk of water pooling at the lowest point within a landscape's sub-grading, and of compromising the even leveling/grading of installed pavers, perforated PVC pipes are used to drain excess water away from hardscape boundaries.[2]

Manufacturer Engagement and Data Access Challenges

In researching the supply chain for concrete permeable pavers, our team reached out to five (5) concrete permeable paver manufacturing companies, one (1) jointing compound company, and one (1) admixture company. Three of these companies are typically specified by NYC Parks. The acronym we are using in this report for this family of material products is PP1, PP2, PP3, and so on.

Of all materials investigated, permeable paver companies had the highest response rate to our Manufacturer's Questionnaire, with all but one company starting the Questionnaire. Two of the six respondents left the 24 questions largely unanswered. PP1 and PP5 answered about 80% of the questionnaire, while the other four answered 30% or less. PP1 and PP5's answers included information on the materials in their concrete mixes and their first-tier suppliers. Our research team member who reached out to these companies has a working relationship with sales representatives from PP1 and PP5 who advised her work on two previous NYC public projects. It only took emailing once to get their engagement and additional company contacts. PP6 responded quickly as they too established a relationship with MNLA after they conducted an in-office "Lunch and Learn". In other cases, our team member followed up, emailing twice before calling. This way we ultimately engaged sales representatives from PP2, PP3, and PP4.

Figure 5.04, Permeable Paver at Streetscape, Credit MNLA

In one case, the company's responses were offered by their Director of Sustainability. For the other four paver companies, sales representatives responded to the Questionnaire. In the case of the Director of Sustainability, their job responsibilities included reviewing the company's supply chain for ethical practices and for sustainability policy compliance. They noted that when conducting audits for their first-tier suppliers, this was an informal process. Our Questionnaire answers confirmed that industry giants Holcim/Lafarge, among others, are sources for sand, stones, stone chips, and cement powder, sourced locally. In some cases, pigments are sourced from Asia, although the specific location is unknown. Less information was known about the source of any additives to the mixture.

We've observed that those charged with a company's Sustainability mission may not be privy to the organization's entire supply chain, being primarily informed of the information that helps them meet benchmark sustainability ESG compliance requirements. Sales representatives are even less aware of a

company's supply chain. When we sought to continue the conversation with sales representatives who completed the Questionnaire on behalf of their companies, most indicated they needed to check in with management, yet they did not follow up.

In the case of other companies that responded to the Questionnaire, their answers did not indicate knowledge that any part of their permeable paver was sourced outside the US. First-tier suppliers identified for the procurement of sand, stone, and cement included local, regional suppliers and a midwestern office of Lafarge.

CSR and Sustainability Profile

Hardly ever has MNLA discussed the subject of forced labor with paving manufacturers it specifies on any given project. Our landscape architects, in decades of professional engagement, have had little opportunity to discuss this question with our material suppliers. As such, it is not entirely surprising that public statements and company adverts on policies against forced labor are not entirely forthcoming. Only one company, PP1, provided a statement against forced labor in their supply chains, which they've posted to their website. PP2, PP3, PP4, and PP5 share no information on their websites regarding efforts to reduce the risk of forced labor in their supply chains.

PP1, PP2, and PP5 also have sustainability statements posted to their websites, but they do not more broadly include social sustainability considerations.

- One company, PP1, offered Environmental Product Declarations (EPDs) for their product, along with a statement on human rights and ethics.
- PP2 did not have EPDs or HPDs but shared a Red List Declaration.
- We located HPDs for a permeable paver from PP5, although they were self-assessed. They also have HPDs for other products. They did not have EPDs to offer at this time. In conversation with PP5, they noted that it would take too many resources to make EPDs for each of their numerous paver types.
- PP3 and PP4 did not respond to our request for HPDs or EPDs.

It should be noted that in the past, NYC Parks did not require the submission of HPDs or EPDs by companies interested in being awarded NYC Parks projects. HPDs and EPDs for concrete products are encouraged but not required in this pilot. It is surprising that this kind of information is not asked for given that permeable pavers and their jointing compounds, chosen because they drain water into our surrounding environment, facilitates the transfer of runoff water into our drinking water, streams, and groundwater. These are precisely the kinds of materials that should be vetted for health and safety requirements, let alone screened for the risk of forced labor in their supply chains.

Forced Labor Risks for Permeable Pavers

The Material in the News

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component as PP1 to PP7)

Permeable paver companies have been in the news for several reasons. Some companies have sued competitors for infringing on product exclusivity by replicating known products, while others have accused their suppliers of delivering underperforming materials. With regards to questions of labor, Unilock, was litigated by close to three hundred of its primarily Hispanic employees, for having been "*wrongfully denied overtime wages because of Unilock's illegal timekeeping and payroll practices.*"[3] As reported by The Law Office of Colleen M. McLaughlin, who represented the employees, Unilock was accused of five workplace violations. This included "*a Unilock manager routinely altered employee timecards by hand so that employees would only get paid for the time on the schedule no matter what time they actually started or stopped working.*"[4] A 1.6-million-dollar settlement was won by the employees in 2010.

In what concerns forced labor, stone and sand are essential to the production of concrete and significant sources of compromised labor across the world. The 2024 "List of Goods Produced by Child Labor or Forced Labor," published by the US Government Department of Labor identifies stone, granite, gravel, and sand as at-risk materials for both forced and child labor. India, Kenya, Madagascar, Nepal, Tanzania, Uganda, Zambia, Egypt, Paraguay, and Nicaragua are all countries at risk for Stone; Burkina Faso, Nigeria, Sierra Leone, and Benin are at risk for Granite; Guatemala, Nicaragua, and Nigeria are at risk for Gravel (crushed stones); Kenya, Nigeria, and Uganda are at risk for Sand; India is at risk for Sandstone. And because no concrete can be made without Portland cement, of which gypsum mineral is a key ingredient, Niger is at risk for forced labor in this category.[5]

The making of concrete has, more particularly, been at the center of human rights abuses during the past 5 years. One of the most important global suppliers of cementitious products to the industry, Holcim/Lafarge has been charged with having violated the human rights of Syrians during the armed conflict in 2012 and 2014.[6] It is alleged the company paid millions of dollars to the terrorist group (IS) Islamic State in order to keep their operations running during the war, and into so doing imperiling the lives of its employees. Eleven employees and communities directly impacted by the war are suing the company.[7]

In August 2025, Caustic Soda (sodium hydroxide) was added to the list of priority sectors whose products if made in the Xinjiang region (XUAR) of China are barred from entry into the United States.[8] This material is now tracked in the US Government Department of Labor, "List of Goods Produced by Child Labor or Forced Labor."[9] China is at this time the only country identified at risk of producing this material using forced or child labor. And while this material is not typically used to the make Portland cement, it is an admixture used in the making of plasticizers. We did identify this material in the supply chain of one of the companies we analyzed, having originated in Xinjiang China, yet buried in the fourth tier of its supply chain.

What Does Sayari Reveal?

Our team's initial assessment is that there are three main areas in the permeable paver assembly that are at risk of having their supply chains compromised by forced labor: these being the stone particulates, the joint filler, and any admixtures. Geotextiles and PVC pipes (furnished by others) are also at risk but discussed in other portions of this report. It is reasonable to assume that given the high cost of transporting aggregates, it is most likely that contractors acquire them locally for NYC public projects. The local extraction and production of stone, gravel, and sand have a lower risk of forced labor, given US labor laws that prohibit forced labor on job sites. However, as discussed in section 4.4 of this report, there are instances where compromised labor practices take place on construction sites in NYC.

The greatest risk of forced labor in the paver assembly occurs in material components that are not entirely made in the United States. Specialty stone particulates and resin mixes used in the concrete paver are sometimes the source of forced labor, particularly if they originate in southeast Asia and Asia. Another possible site of forced labor in the supply chain of this assembly is in the packaging made of plastic sheets and ties. As the food and clothing industries have begun to consider packaging as a possible source of forced labor, so too must we consider the construction industry's packaging practices.

This is the assessed risk profile of the companies we studied using Sayari.

- PP6, is a joint/mortar company with insufficient information in Sayari to review.

- PP3, is a permeable paver company with a limited trade profile in Sayari. At this time, Sayari does not indicate a direct risk for forced labor, although it does have risk in its second-tier suppliers. A second-tier company is at direct risk for Elevated Forced Labor of [3], and two third tier companies that supply this company are at Elevated Forced Labor risks of [3] and [6] in its supply chains.

- PP2, is a permeable paver company in Sayari which receives (5) material products that are tracked in Sayari: one first tier company has an elevated risk of forced labor. Shipment data indicates that PP2 receives Ceramic tiles, flags and paving, hearth or wall tiles from a supplier with an Elevated Forced Labor risk of [6].

- PP4, is a permeable paver company whose data in Sayari indicates that they import steel strappings from a company operating out of Greece with an Elevated Risk for Forced Labor [2] in their history, (and a High Risk for Political Exposure [3]). This supply chain also has in its fourth-tier, caustic soda that originates in one of (144) entities whose products have been banned in the US, this being the Xinjiang Zhongtai Import Export Co. LTD.

- PP7, is a company that supplies admixtures to the precast concrete industry, which produces permeable pavers. While we tend to think of precast pavers as made of cementitious products, they also include synthetic polymers added as plasticizers to make them more workable during setting and curing. These materials are at high risk of forced labor in their supply chains, being, for the most part, petrochemical in

their origins. We will discuss this issue further across the remainder of this report when dealing with landscape products that originate in petrochemicals from a handful of sources.

*Of note, during the research phase of this project, PP7 was a product submitted by a local NY C subcontractor during the contract administration of a landscape project for approval by MNLA on one of their design projects.

- PP5, is the one permeable paver company we can identify in the category of immediate and High Risk for Forced Labor. Sayari's report on this company claims it is at direct risk for Elevated Forced Labor [2]. This is attributed to the company itself. We have further identified that in one supply chain a first-tier supplier from Italy of abrasives for marble and granite, such as millstones and grindstones, is cited for Elevated Forced Labor risk of [2], and at its second tier a company that supplies stone and quartzite is identified with Elevated Forced Labor risk of [5] and a High Forced Labor risk of [2]. In another supply chain for PPR, a secondary-tier supplier from Vietnam with an Elevated Forced Labor risk of [7], furnishes artificial paving stones with quartz aggregate.

- PP1, is a permeable paver company with many subsidiaries, all of whom have a different trade data profile in Sayari and hence a different evaluation of their risk. Moreover, this company has had a changing risk profile during 2025. In March PP1, Sayari data indicated that it had received stone shipments from a company in Sri Lanka, which at the time was identified as being at risk for forced labor. Later, this was no longer the case.

- One subsidiary of PP1, is identified with the light green risk factor because none of its first-tier companies indicate a risk of forced labor.

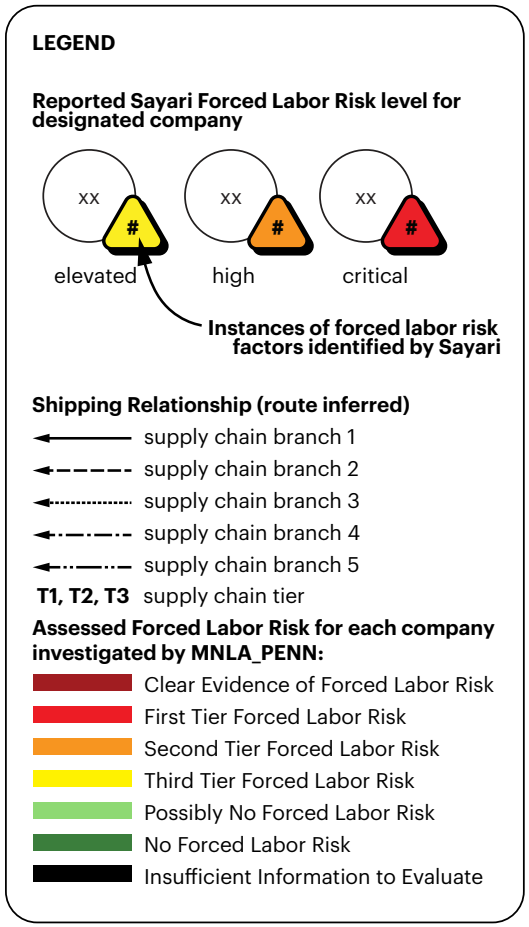
- Another subsidiary (in New York) is identified with the orange risk level because there is a company in its second tier with an Elevated Forced Labor risk of [4].

- Two additional subsidiaries of this company are identified with the light red risk level for forced labor because their Chicago and Ohio divisions receive products from companies with Elevated Forced Labor risks across multiple tiers. The first-tier company has an Elevated Forced Labor risk of [7], two second tier companies of this same supply chain have Elevated Forced Labor risks of [8] and [5] respectively.

Diagram of Global Supply Chain Risk

PP2

This image is a partial mapping of PP2's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.



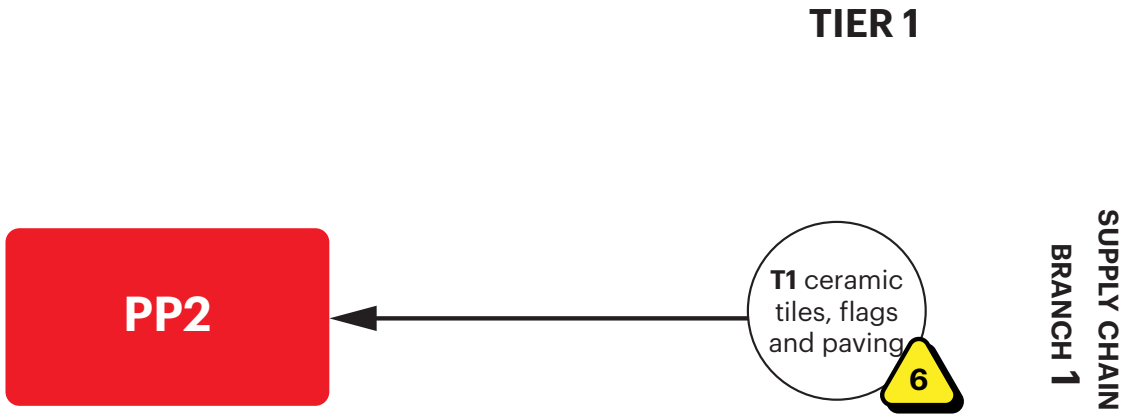
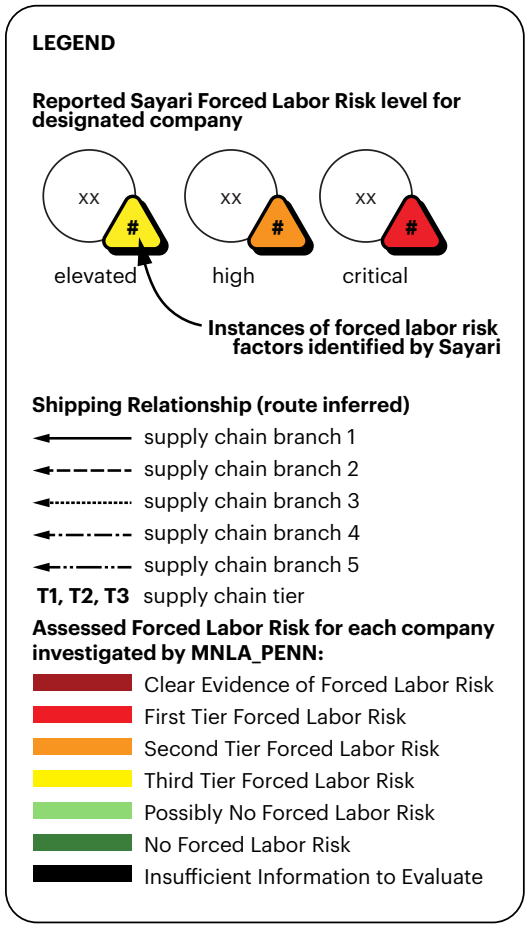


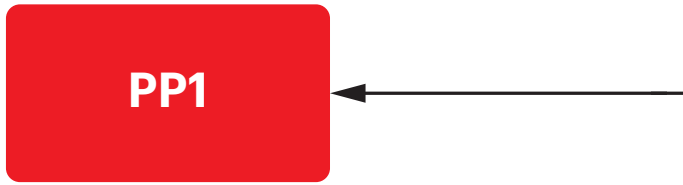
Figure 5.05, Diagram of Global Supply Chain Risk: PP2, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

PP1

This image is a partial mapping of PP1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





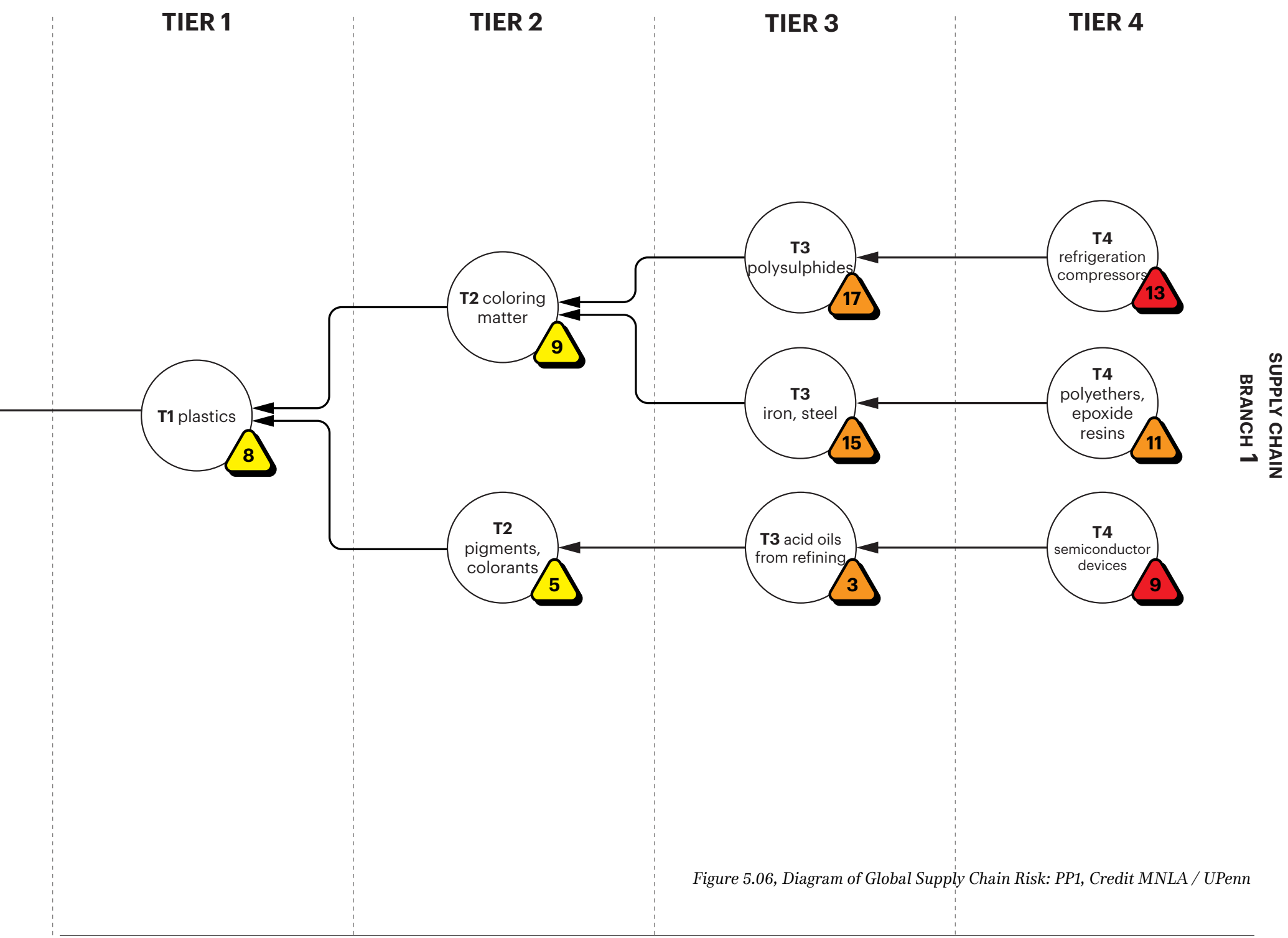


Figure 5.06, Diagram of Global Supply Chain Risk: PP1, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

PP1

This image is a partial mapping of PP1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

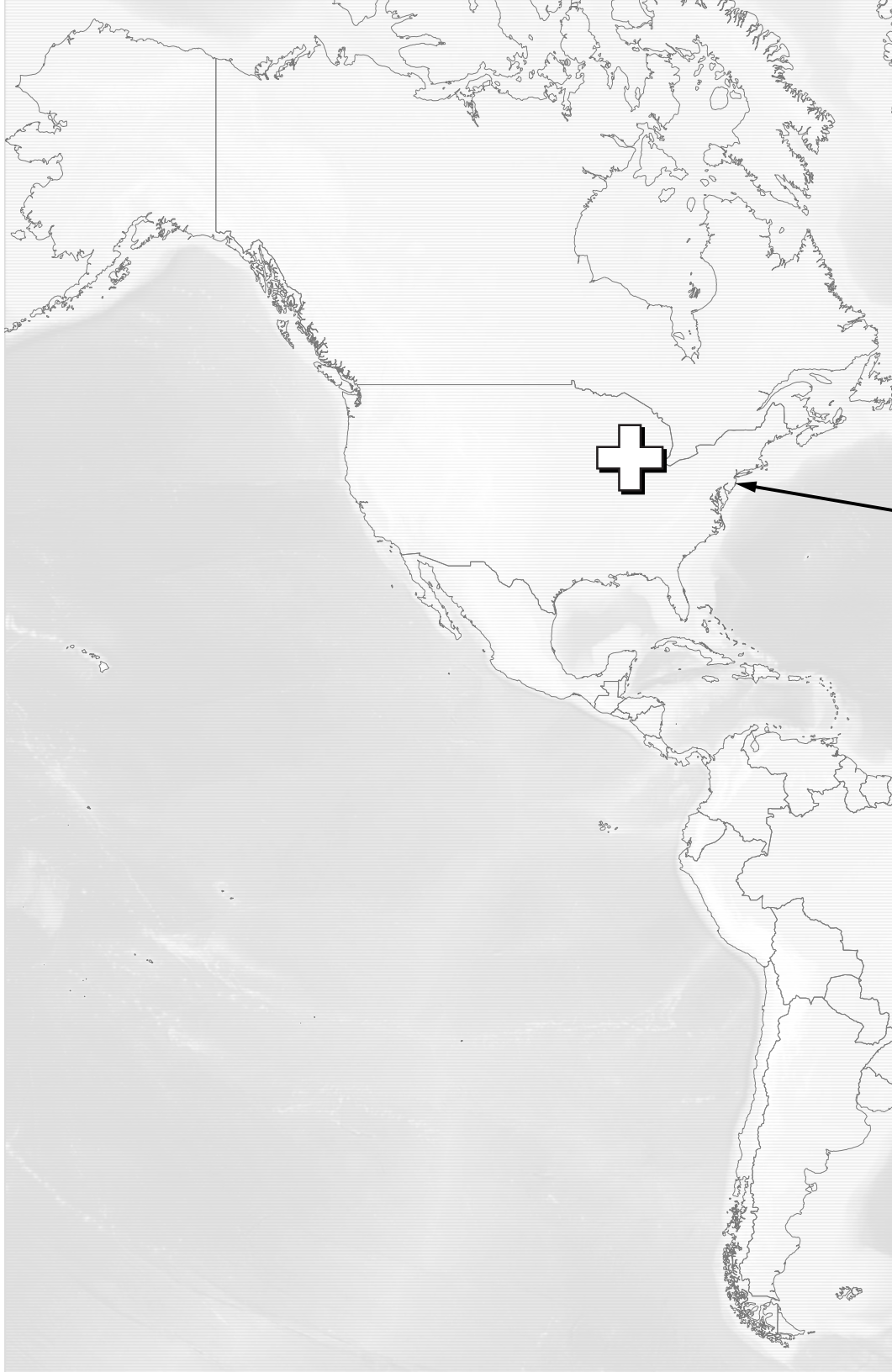
Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate



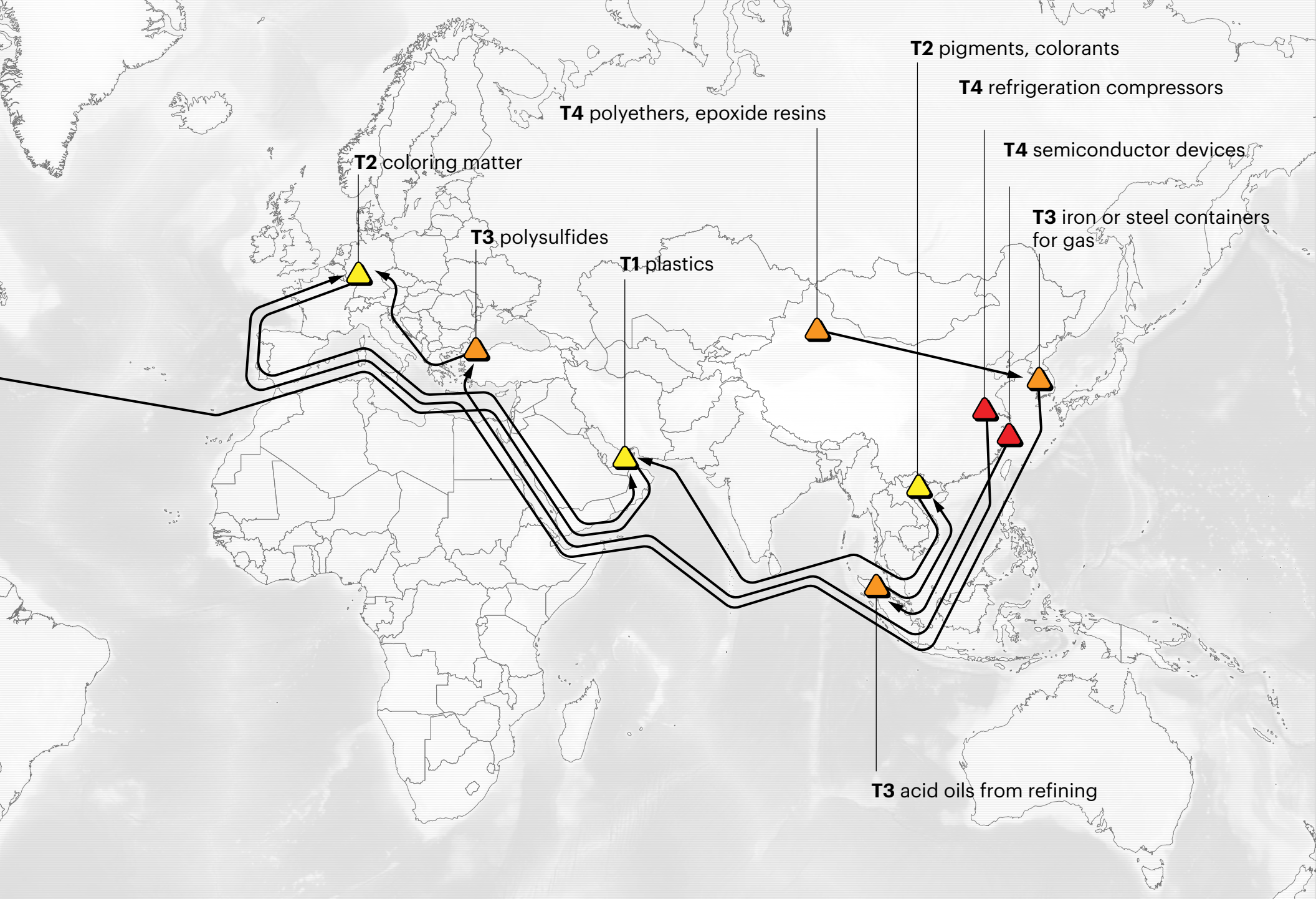
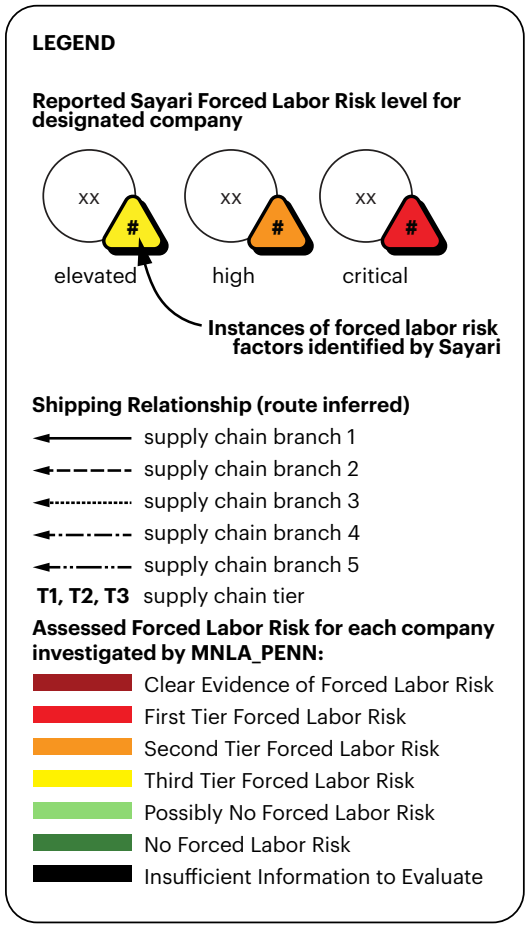


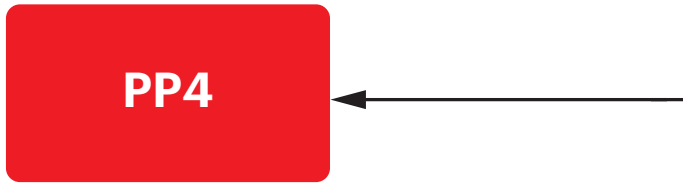
Figure 5.07, Shipping Map of Global Supply Chain Risk: PP1, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

PP4

This image is a partial mapping of PP4's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





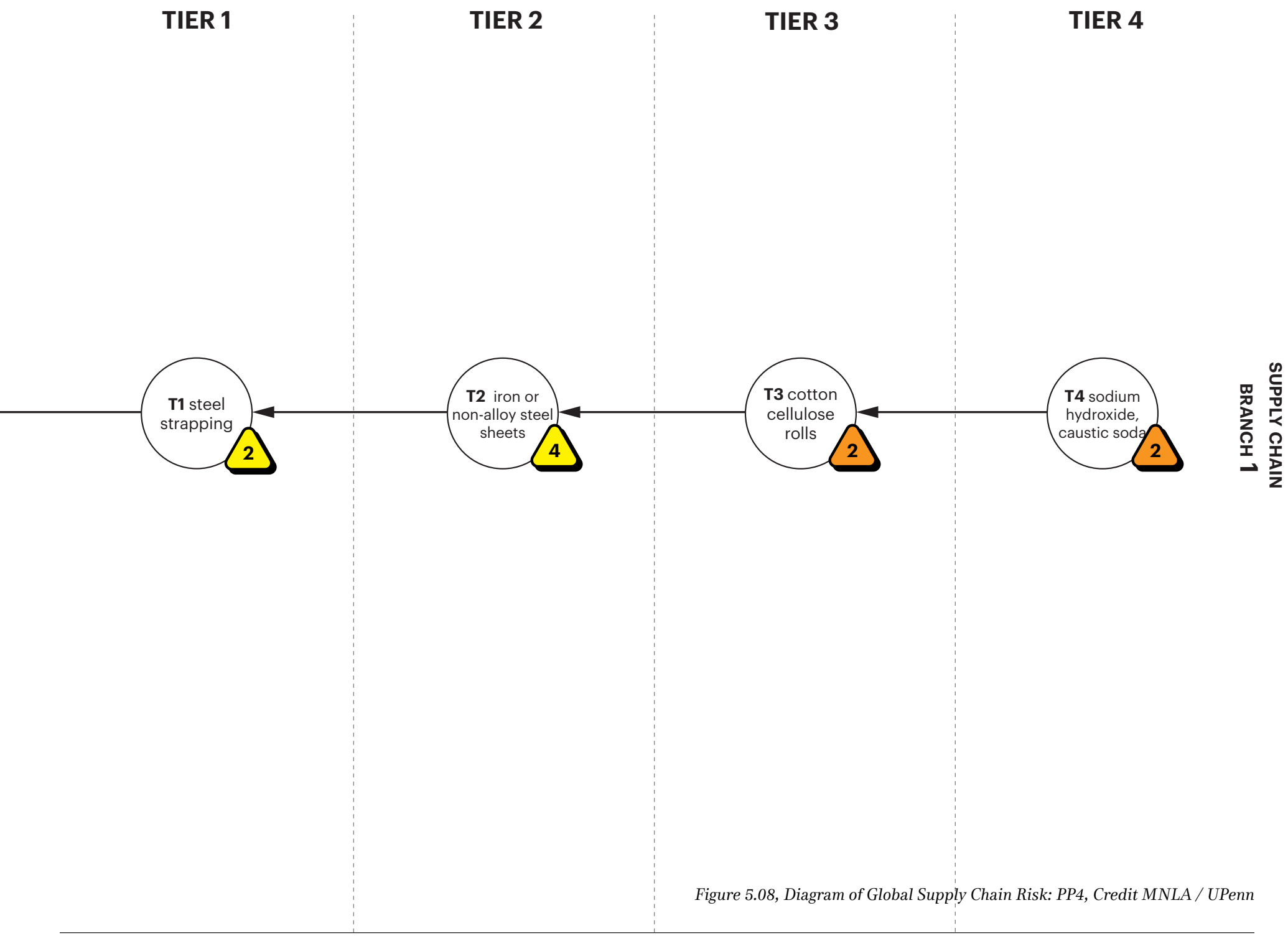
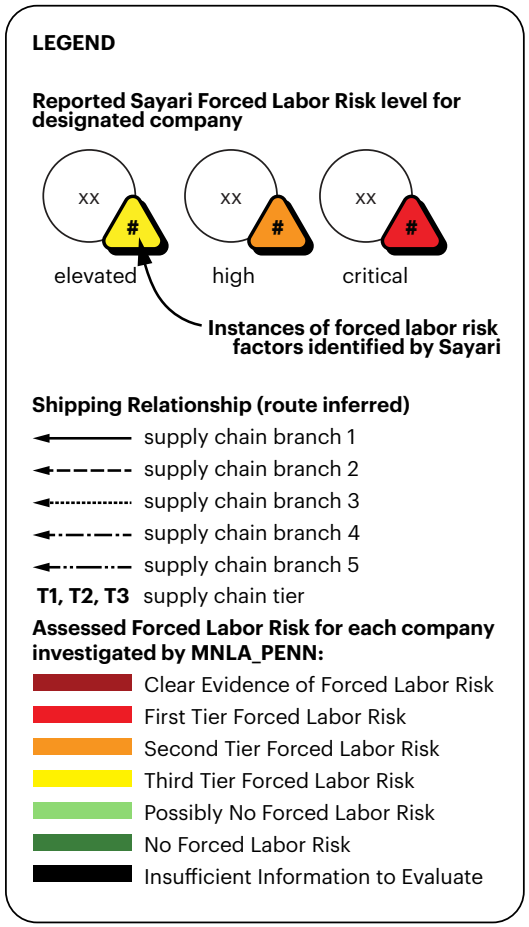


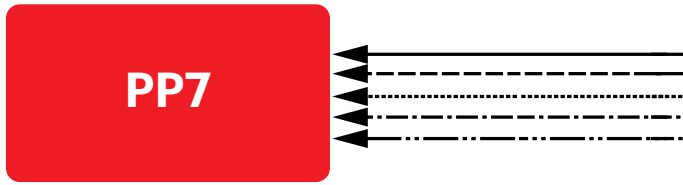
Figure 5.08, Diagram of Global Supply Chain Risk: PP4, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

PP7

This image is a partial mapping of PP7's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





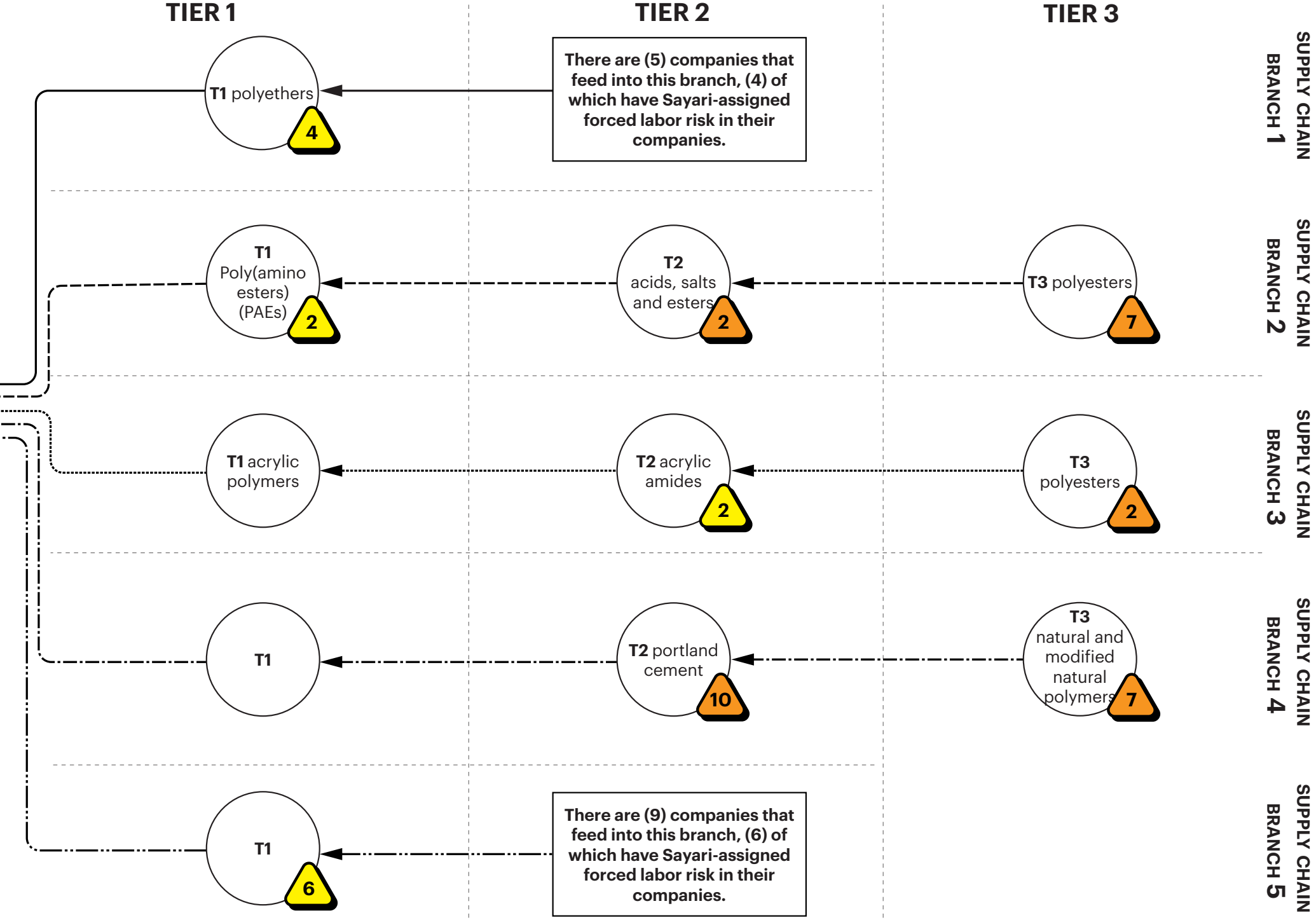
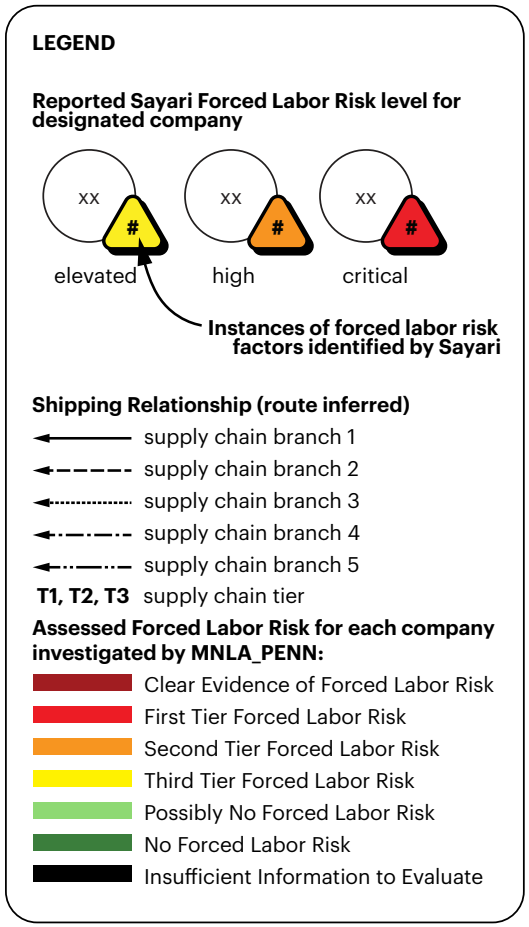


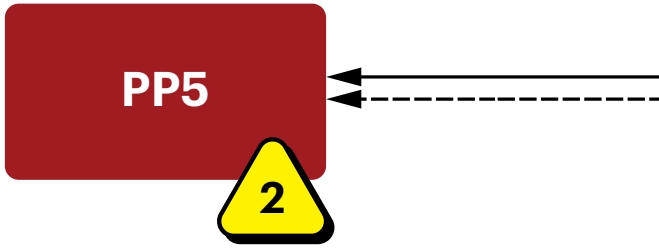
Figure 5.09, Diagram of Global Supply Chain Risk: PP7, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

PP5

This image is a partial mapping of PP5's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





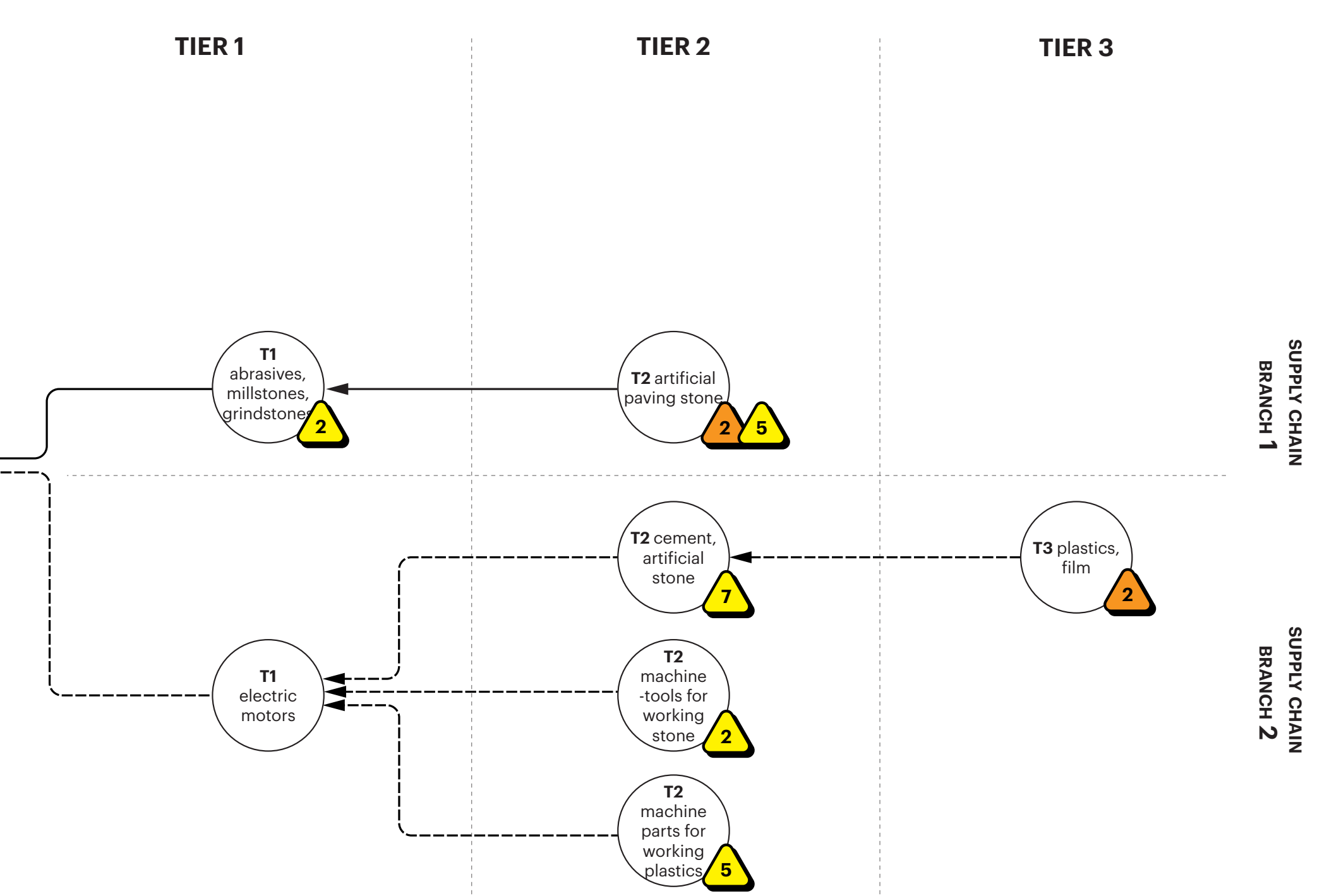
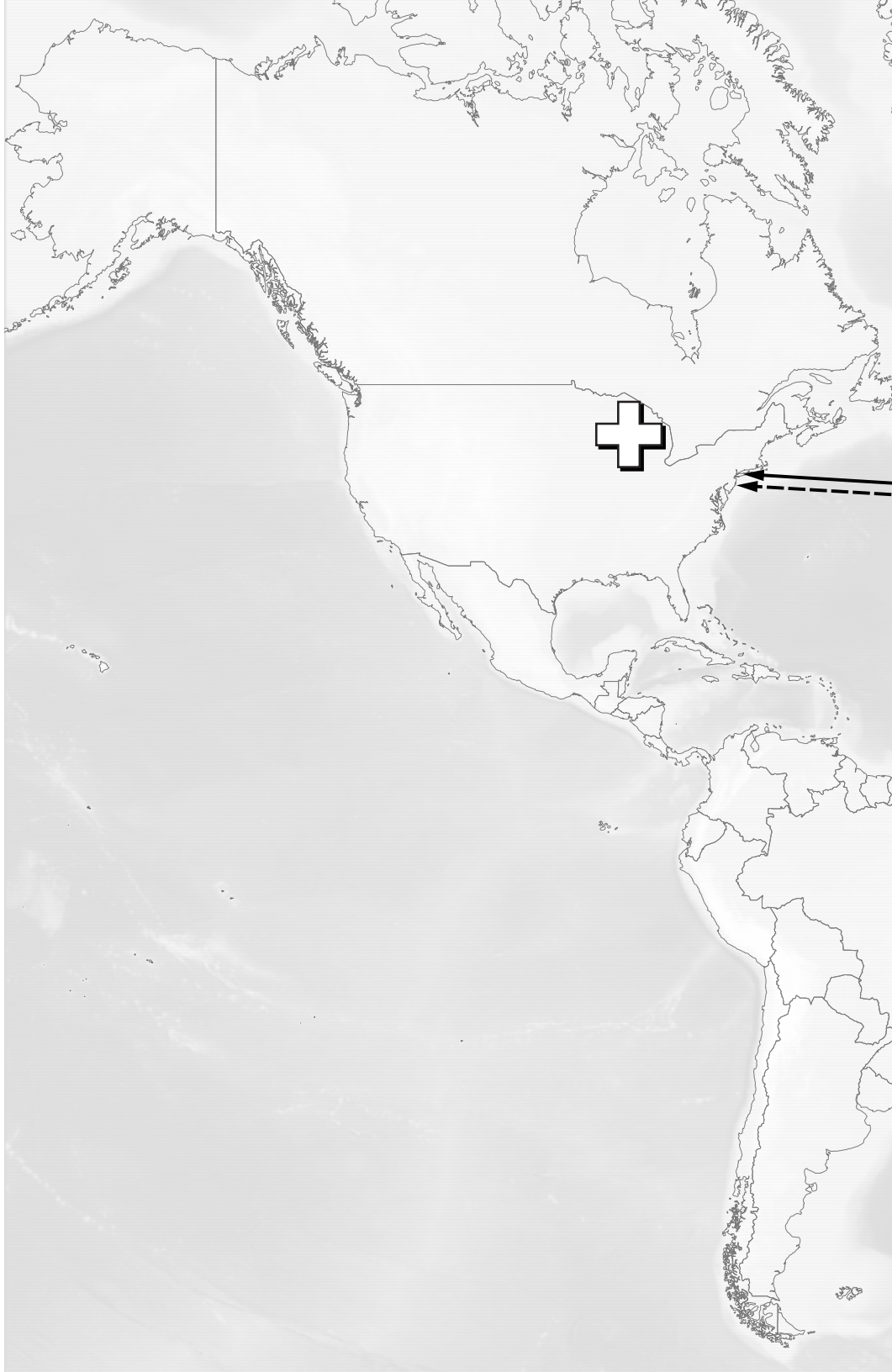


Figure 5.10, Diagram of Global Supply Chain Risk: PP5, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

PP5

This image is a partial mapping of PP5's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.



LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate

Figure 5.11, Shipping Map of Global Supply Chain Risk: PP1, Credit MNLA / UPenn

Endnotes

[1] Naphta is a form of liquid petroleum based in hydrocarbons and highly flammable. Ethylhexanoic acid is a precursor to plasticizers and lubricants. Both materials are considered toxic in some form and across some aspect of its life cycle. See "New Jersey Department of Health and Senior Services – Hazardous Substance Fact Sheet," https://nj.gov/health/eoh/rtkweb/documents/fs/0518.pdf ; see "2-Ethylhexanoic Acid (2-EHA)" , Vermont Department of Health, https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_CDP_149_57_5_2-EHA.pdf.

[2] Charles W. Harris, *Time-Saver Standards for Landscape Architecture* 2E, (McGraw Hill, 2023): 910-919.

[3] Law Offices of Colleen M. McLaughlin, "Overview of Unilock Class Action Overtime Lawsuit and Settlement,", https://www.cmmclaw.com/overview-of-unilock-class-action/

[4] Ibid.

[5] US Department of Labor, "2024 List of Goods Produced by Child, Labor, Or Forced Labor", https://www.dol.gov/sites/dolgov/files/ILAB/child_labor_reports/tda2023/2024-tvpra-list-of-goods.pdf

[6] ECCHR, European Center for Constitutional and Human Rights, "Lafarge in Syria: Accusations of complicity in grave human rights violations," https://www.ecchr.eu/en/case/lafarge-in-syria-accusations-of-complicity-in-grave-human-rights-violations/ ; Samanth Subramanian, "The cement company that paid millions to Isis: was Lafarge complicit in crimes against humanity?" , *The Guardian*, September 17, 2024, https://www.theguardian.com/world/2024/sep/17/french-cement-company-lafarge-paid-millions-to-islamic-state-syria

[7] Agence France-Presse, "Nobel laureate sues French concrete maker Lafarge over alleged Islamic State support," *The Guardian*, December 16, 2023, https://www.theguardian.com/world/2023/dec/16/nobel-laureate-sues-french-concrete-maker-lafarge-over-alleged-islamic-state-support

[8] "US Department of Labor Announces Joint Strategy Targeting Forced Labor In China To Protect American Workers," August 19, 2025, https://www.dol.gov/newsroom/releases/ilab/ilab20250819

[9] US Department of Labor, "2024 List of Goods Produced by Child, Labor, Or Forced Labor", and " Against Their Will: The Situation in Xinjiang" , https://www.dol.gov/agencies/ilab/against-their-will-the-situation-in-xinjiang

This page is intentionally left blank

5.2
Geotextile

Kane Park Geotextile Installation, Credit MNLA

GEOTEXTILE DETAIL

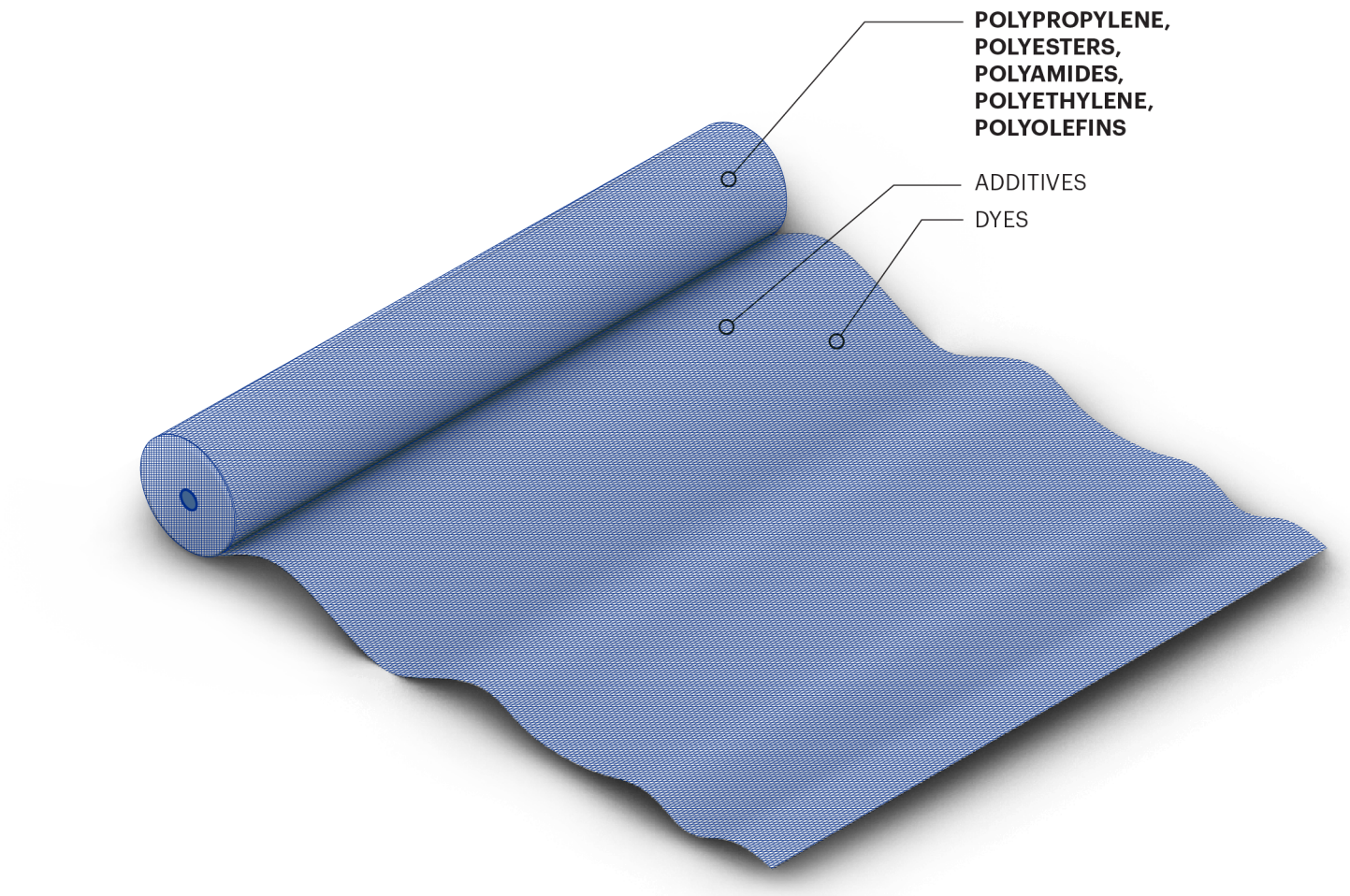


Figure 5.12, Geotextile Detail, Credit MNLA

5.2 GEOTEXTILE

What are Geotextiles and why are they used?

Geotextiles are one of the most ubiquitously employed products in landscape projects. Invisible, yet pervasive in the design and construction of landscapes, geotextiles are essential to landscape performance. They are used in many applications including, but not limited to, soil stabilization, weed suppression, erosion control, and drainage improvements. Geotextiles are critical building blocks for other assemblies common in constructed landscapes. While there is no stand-alone detail for installing a geotextile (as this depends on its application which could be a synthetic turf installation, civil infrastructure project, underneath permeable pavers, as part of a green roof system, water retention pond, etc.) there are typical installations for best performance.[1]

So common are they,

> *"the global geotextiles market size was valued at USD 3.39 billion in 2023 and is projected to grow from USD 3.62 billion in 2024 to USD 6.14 billion by 2032, ... Asia Pacific dominated the geotextiles market with a market share of 34.81% in 2023. Moreover, the geotextile market size in the U.S. is projected to grow significantly, reaching an estimated value of USD 0.98 billion by 2032, driven by the explosive growth of the automotive and house refurbishment industry, as well as the growing fibers industry."*[2]

In what concerns its used by NYC Parks, according to data we received from the FOIL (Freedom of Information Law) request, Geotextile accounted for 0.25% of contract value for 2018, 0.08% for 2019 and 0.07% for 2022. Geotextiles are not expensive products compared to the cost of finishing materials, such as concretes slabs, granite curbs, and synthetic turf, yet they are extensively and widely used.

Figure 5.13 Geotextile Installation, Credit MNLA

Material Composition and Manufacturing

Geotextiles can be made of synthetic polymers and natural materials. The most common natural materials used are jute, coir (from coconut husks), and sisal. Polymers used in the manufacture of geotextile include polyesters, polyamides, polyethylene, and polyolefins. The products studied in this project are all derived from polypropylene as this is what is preferred and specified by NYC Parks.

In the manufacturing of polymer-based geotextiles, fossil fuels such as petroleum and natural gas are cracked to form propylene, a gas. Gaseous propylene is fractionally distilled to create a purified form of propylene which is then polymerized to create polypropylene pellets.[3] These pellets are melted and extruded to form synthetic fibers which are sometimes referred to as yarns or filaments. The fibers are then either woven or needle-punched (or heat- or chemically-bonded) to create the geotextiles commonly used in landscape architecture.[4]

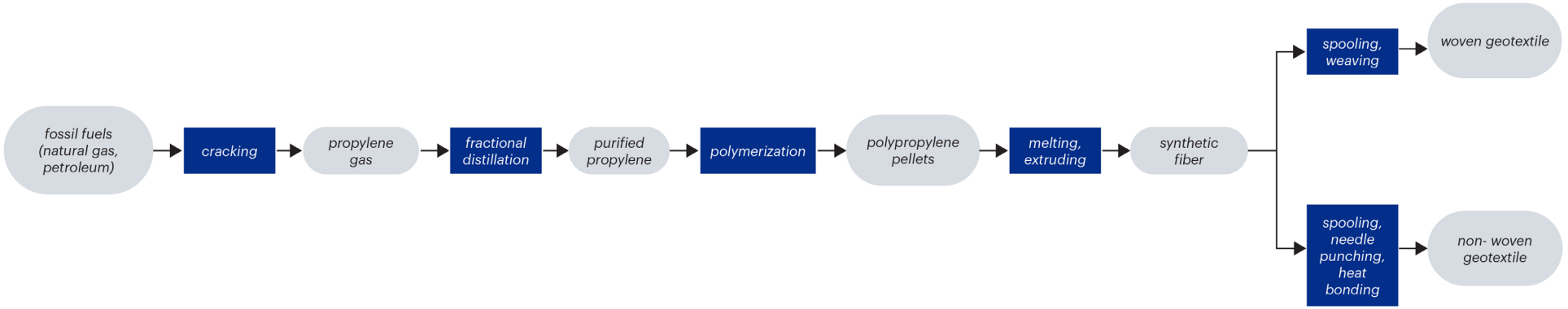
The following descriptions are how each of these companies advertise their product:

- GEO1: 100% polypropylene staple filaments needle-punched and heat set
- GEO2: high-tenacity polypropylene yarns
- GEO3: needle-punched non-woven geotextile composed of polypropylene fibers
- GEO4: 100% staple polyester and polypropylene needle-punched filter fabric
- GEO5: non-woven 100% recycled polypropylene fibers tightly needle-punched together

Manufacturer Engagement and Data Access Challenges

A member of the team investigated five different companies as part of this research. The chosen acronym for geotextiles is GEO1, GEO2, GEO3 etc. Of the products studied, one was a woven geotextile (GEO1) and the others were needle-punched nonwoven geotextiles. None of the geotextile companies participated in the Manufacturers' Questionnaire distributed by the team, despite multiple outreach efforts encouraging them to do so. The representative from GEO1 was particularly responsive to direct questions by email, but responses from this company ceased during Phase 3 of research. Representatives from GEO2, GEO3 and GEO5 responded to some, but not all, email correspondence.

GEOTEXTILE MATERIAL PROCESS DIAGRAM



Sample mapping of geotextile manufacturing process

New graphic based on content from:

Hasan, Redwanul. "An Overview of Geotextiles: Industrial Application in Technical Textiles." Journal of Textile Science & Fashion Technology. Iris Publishers. January 21, 2020.

Mikhael, Elissar, Abdelmalek Bouazza, Will P. Gates, and Daniel Gibbs. "Are Geotextiles Silent Contributors of Ultrashort Chain PFASs to the Environment?" Environmental Science & Technology. 2024.

Wu, Hao, Chongkai Yao, Chenghan Li, Miao Miao, Yujian Zhong, Yuquan Lu and Tong Lui. "Review of Application and Innovation of Geotextiles in Geotechnical Engineering." Materials. 2020.

Figure 5.14, Geotextile Material Process Diagram, Credit MNLA

Corporate Social Responsibility Profile

When asked if EPDs, HPDs or sustainability certificates were available for each product, GEO 1 did not have any; GEO 2 did not respond; GEO3 did not have an EPD or HPD for the specific product our team was researching, but they do have EPDs for some of their other material products; GEO4 was unreachable; and GEO 5 provided an EPD for Cradle-to-Grave. GEO 1 and GEO 2 have publicly available documents indicating that their products meet the requirements of "Build America, Buy America". Our research indicates that GEO1 and GEO3 are produced at the same facility. Additionally, GEO 5 publishes an annual Sustainability Report on their website.

As the research team reviewed corporate social responsibility statements, the following information was found:

- GEO 1: has no corporate statements on forced labor, human rights or the environment. The parent company of GEO1 has a sustainability statement that claims to uphold the highest ethical standards and, through responsible action, also claims to take care of people, communities, their products and the planet.

- GEO 2: the parent company of GEO 2 has a Human Rights statement dated 2023 that forbids the use of forced or compulsory labor within their company and is invested in creating a global supply chain that ensures workers are informed, compensated for their jobs and able to move at will. The statement also prohibits child labor within the parent company and its suppliers under local legal employment ages.

- GEO 3: has a code of conduct page on their website which discusses their commitment to human rights and their restriction of forced labor that includes gender, race, political and religious affiliations, sexual orientation and other means of discrimination. The statement references the Universal Declaration of Human Rights and denounces harassment, intimidation, child- and forced-labor, human trafficking and other means of abuse. GEO 3 also has a Sustainability Officer.

- GEO 4: has no corporate statements on forced labor, human rights or the environment.

- GEO 5: has a human rights statement that declares the safeguarding of human and labor rights. GEO 5 has signed the UN Global Compact, has a Code of Conduct, a Supplier Code of Conduct, and an annual ESG Confirmation. GEO 5 advocates for fair compensation, equal opportunity, the eradication of forced, slave and child labor as well as various forms of discrimination. Acknowledging that their reach expands globally and that they operate in high-risk regions, GEO 5 claims to be aware of their own culpability and purports to take responsibility for ensuring that there are no violations.

Furthermore, GEO 5 has a statement on Child and Forced Labor that prohibits child labor and enforces this by having all Tier 1 suppliers sign their Supplier Code of Conduct. Various measures are in place to support this including a Trust Line, speak-up channels, systems for training and monitoring, supplier audits and yearly audits. GEO 5's Child and Forced Labor statement references both the 10 UN Global Compact Principles as well as the UNICEF Index of Children's Rights in the Workplace.

GEO 5 also has a disclosure statement on the California Transparency in Supply Chains Act of 2010 including measures for verification, audits, materials, accountability standards and training to eradicate human trafficking and slavery in their supply chain.

GEO 5's Sustainability Report (2024), published annually on their website, claims sustainability is at the heart of the company and identifies its goals as: climate change mitigation, energy, water, resource efficiency and circularity, safety, product stewardship, and regulatory compliance and advocacy.

FORCED LABOR RISKS FOR GEOTEXTILES

The Material in the News:

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component as GEO1 to GEO5)

Given this a highly ubiquitous material for landscape architects, it plays an outsized role in the evaluation of forced labor in the construction industry. Its material origins and fabrication methods (primarily from synthetic polymer threads) means that geotextiles are comparable in their supply chains to other fabric-based industries and production cycles. Some geotextile companies appear in the supply chain of garment textiles for example, as they share supplier companies for their material pellets. This is notable when reviewing open-source software such as Supply Trace (https://supplytrace.org) which

is typically used by the garment industry, but which in our case helps us trace shipments to GEO1 and GEO2. The evidence garnered using Supply Trace regarding the risk of forced labor in their supply chains is, however, inconclusive.

Of late, mergers and acquisitions are common in the geotextile industry, and the source of many news stories. In one case, Solmax, a Canadian company headquartered in Quebec, has continued to acquire US production capacity. A source of great pride for La Caisse de dépôt et placement du Québec—"*a financial institution that manages the funds of several public and para-public pension and insurance plans, [and] ... a long-term institutional investor who manages the savings of millions of Quebecers*" – Solmax was already in the polyethylene geotextile business "*specializ[ing] in manufacturing polyethylene geomembranes used in containment systems for domestic, hazardous and industrial waste landfill sites, retention ponds, fracking and heap leaching pads,*" [5] when in 2018 it acquired GSE Environmental, the Houston Texas manufacturer of geotextiles.[6] In 2021, the Caisse announced "Solmax, the world's leading geosynthetics manufacturer, acquires TenCate Geosynthetics."[7] In this, Solmax, "*reached an agreement with Koninklijke Ten Cate (the Netherlands) on the acquisition of TenCate Geosynthetics, a global provider of geosynthetics and industrial fabrics.*" [8] The Caisse is very proud of the market dominance Solmax has in North America. However, without contextualizing or offering evidence for their claims, Solmax claims on their website that, "*Geosynthetics, which replace traditional construction materials, allow reducing the carbon footprint by 35% and project costs by 15%.*" [9] It is unclear how this is so. In 2024, it announced new initiatives to help in the recycling of used geotextiles.[10] And in December 2024, Solmax consolidated its European production to their factory in Bezons, France closing its production site in Austria.[11]

Because geotextiles are typically made of petrochemicals it is not surprising that companies in the business of making polymer-based products for other parts of the building industry are also involved in the making of geotextiles. Sika, for example, is one such company as a large Swiss company with a direct link to the plastics industry. Self-described as,

> "*Sika is a specialty chemicals company with a globally leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing, and protection in the building sector and industrial manufacturing. Sika has subsidiaries in 102 countries around the world and, in over 400 factories, produces innovative technologies for customers worldwide.*" [12]

They make geotextiles, but they also make construction "systems and products for bonding, sealing, damping, reinforcing, and protection." They also purchased in June 2025 a company that produces "concrete admixtures, mortars, flooring, waterproofing and facade systems (EIFS: Exterior Insulation and Finish System").[13] Their advertised commitment to the environment includes initiatives in plastic recycling. In June of this year, they announced a collaborative venture with Sulzer (also a Swiss company) to form a 50% partnership in plastic recycling. They are committed to "developing a system for the collection, processing and reuse of construction plastics using mechanical and chemical processes."[14] Sika also produces its products globally as they announced this year the opening of a manufacturing plant in Kazakhstan.[15] Sika has also acquired competitors such as Dupont Protective Coatings, having announced that "*DuPont Protective Coatings makes products designed to protect concrete, steel and other materials from corrosion, water, fire and environmental forces.*" Amongst the products they acquired are "Permacor, Unitherm, Betonol, Asplit and Epiter".[16] In 2025, Sika also acquired Gulf Additive Factory located in Qatar which produces exterior finishes, façade systems, and waterproofing.[17]

What does Sayari reveal?

In reviewing the risk of forced labor in the supply chain of polymers used in the manufacturing of geotextiles, the risk attributed to some of our companies has changed over the year. This is not surprising, given that several companies that supply polymers to the building industry have recognized the benefits of employing alternate transportation routes to minimize the inherited risk of forced labor in their supply chains. By shipping materials from affected areas to unaffected areas, and by placing one more transportation link between them and most of their suppliers, their risk is not inherited downstream.

It remains the case, however, that at least four of the companies we've looked at are at risk of forced labor in their supply chains: three of which are directly identified as companies with risks of forced labor in their supply chain (or that of a subsidiary), and one has inherited this risk from its second-tier supplier.

Geotextiles, like synthetic turf, are at high risk of forced labor in their supply chains. The evidence from Sayari is clear in that not one company researched is clearly free of forced labor in their supply chain. GEO3 and GEO5 are tainted at four levels of their supply chain, and most companies are only one-tier away from association with companies that are cited for forced labor.

- GEO4, had insufficient information in Sayari to review this company.

- GEO1, is a geotextile company with inherited risk of forced labor in one of its second-tier companies. GEO1 continues to pride itself on being an American company. Today, however, many supply chain searches indicate that GEO1 receives materials from affected areas and from suppliers that have been clearly identified for Critical and High levels of Forced Labor. These include publicly identified companies by Sheffield Hallam, such as the Contemporary Amperex Technology [Critical 1- High 2] company and Xinjiang Markor Chemical [High 8]. GEO1 is a company whose risk profile for forced labor has drastically changed (in Sayari) since we began our investigations in 2024. First tier companies (and additional second tier companies) were previously directly at risk for having forced labor in their supply chain. Over the period of this year, the risk to these companies has been removed.

- GEO2, is a company with many subsidiaries and with significant trading information on Sayari. The geotextile division of this much bigger "textile" company is clearly identified in Sayari. Over the course of the year, this company has had a varying immediate, direct risk of forced labor in its supply chain. On September 16, 2025, the company was at immediate Elevated Risk of Forced Labor [2]. In addition, three of its first-tier suppliers are also at Risk of Forced Labor: two are at Elevated Risk [5] and [1] and one is at High Risk of Forced Labor [10]. This company is also affiliated with a larger brand that has had a significant footprint for poor labor practices, particularly its division associated with textiles used in the clothing industry. The larger brand is one of the only companies from our pool of (34) that is cited in Business & Human Rights Resource Center for significant labor violations.

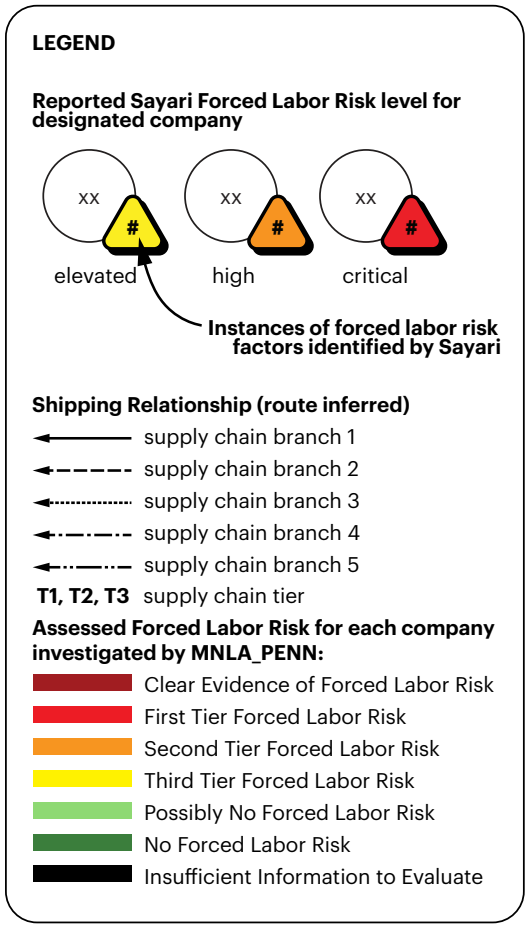
- GEO3, is a company with an immediate Elevated Risk of Forced Labor [2]. Its trading records on Sayari are extensive. In addition, five of its first-tier companies are at immediate risk of Elevated Risk of Forced Labor. All these companies have, in turn, in their first-tier companies that are at Elevated or High Risk of Forced Labor, some as High [13] and [11]. All companies cited for risk are petrochemical companies and three of them have supply chains that source their products from companies identified with the Xinjiang region.

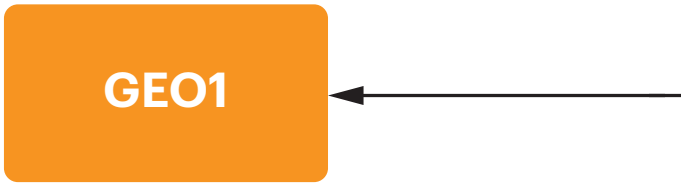
- GEO5 is a significant manufacturer of polymers for the building, automotive and oil and gas industries. For the building industry, they are involved in the making of adhesives, concrete, exterior cladding systems, floors, roofing, waterproofing, and grouts and mortars. Their highly intricate and involved material supply chains also result in geotextile products. Its trading records on Sayari are extensive. This company is at an immediate Elevated Risk of Forced Labor [5]. In addition, five of its first-tier companies are at immediate risk of Elevated and High Risk of Forced Labor: one at High and four at Elevated. All these companies have, in turn, in their first-tier companies that are at Elevated or High Risk of Forced Labor. Most companies cited for risk are petrochemical companies and some have supply chains that source their products from companies identified with the Xinjiang region.

Diagram of Global Supply Chain Risk

GEO1

This image is a partial mapping of GEO1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





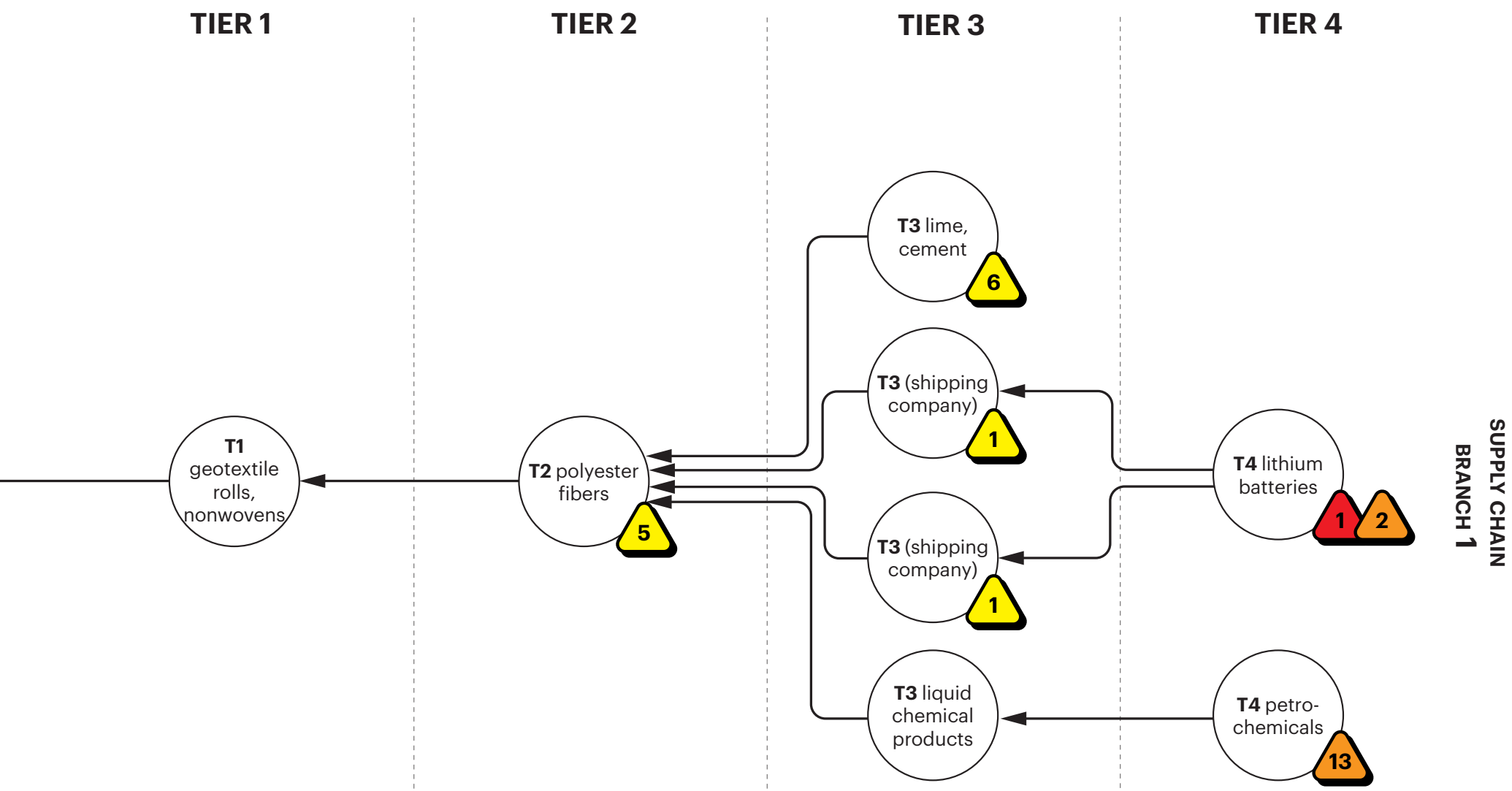


Figure 5.15, Diagram of Global Supply Chain Risk: GEO1, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

GEO1

This image is a partial mapping of GEO1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari. com. Mapped with ESRI and Google Maps.

LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate

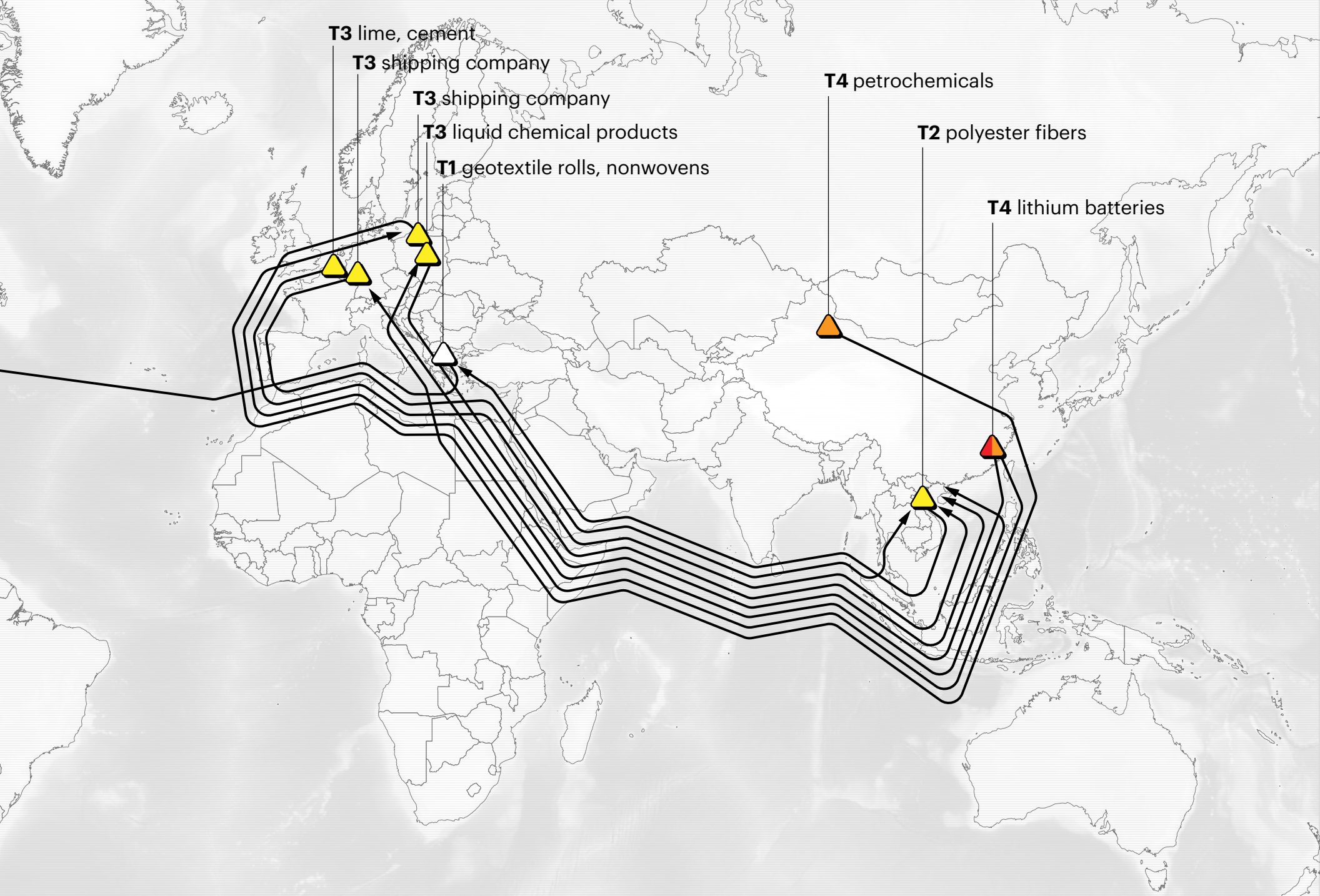
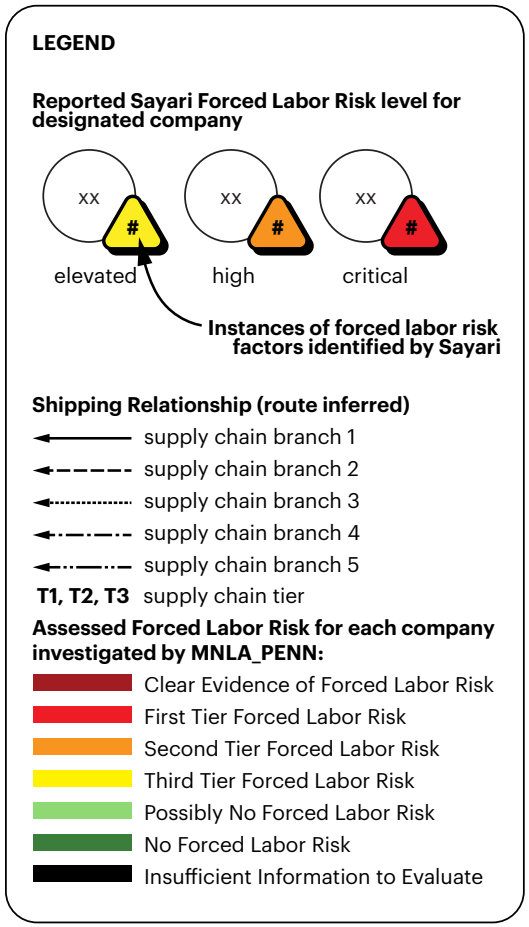


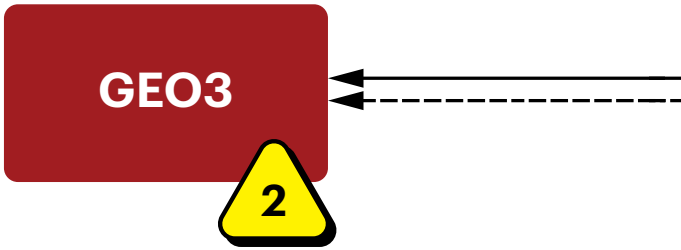
Figure 5.16, Shipping Map of Global Supply Chain Risk: GEO1, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

GEO3

This image is a partial mapping of GEO3's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





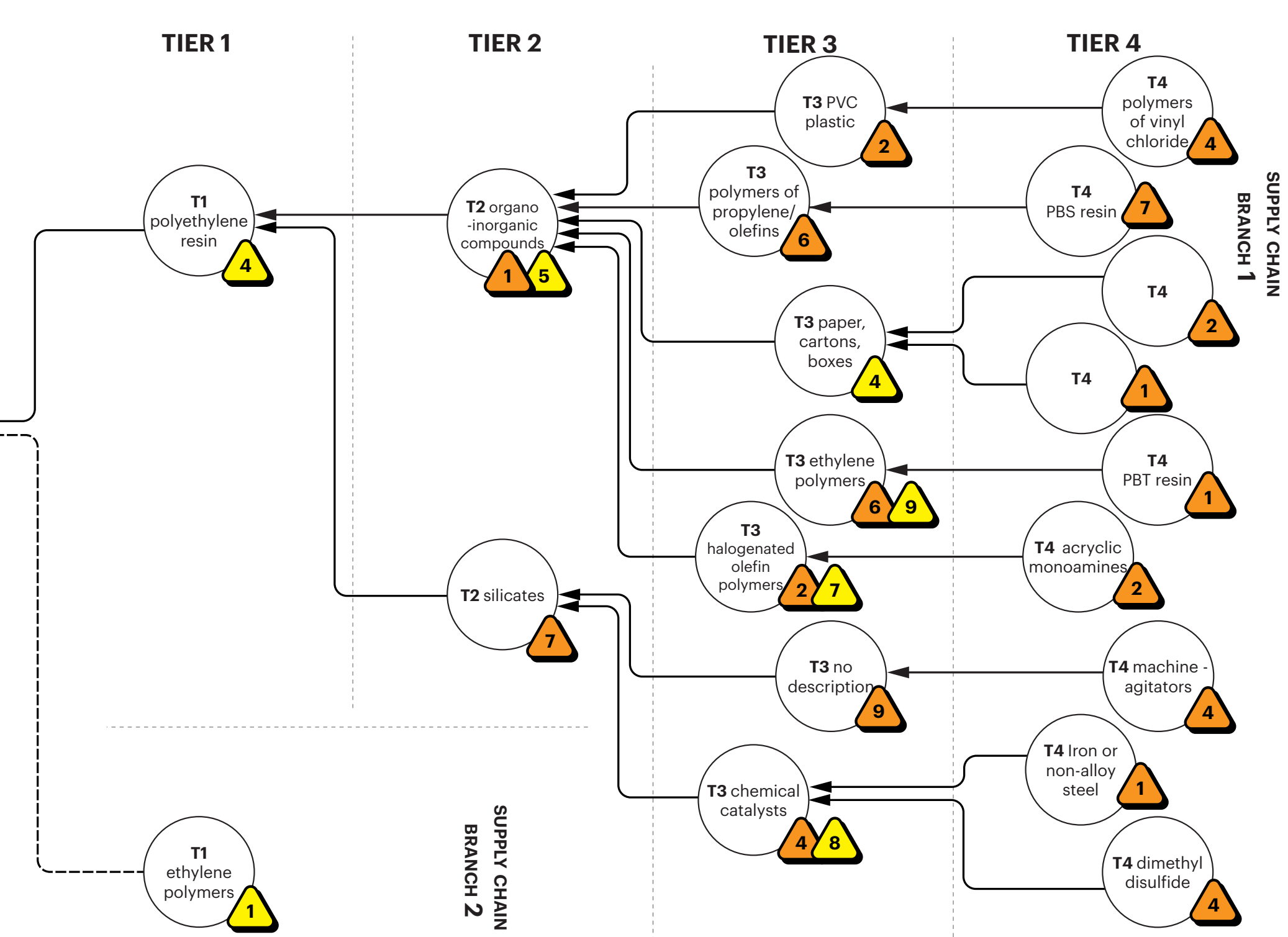


Figure 5.17, Diagram of Global Supply Chain Risk: GEO3, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

GEO3

This image is a partial mapping of GEO3's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

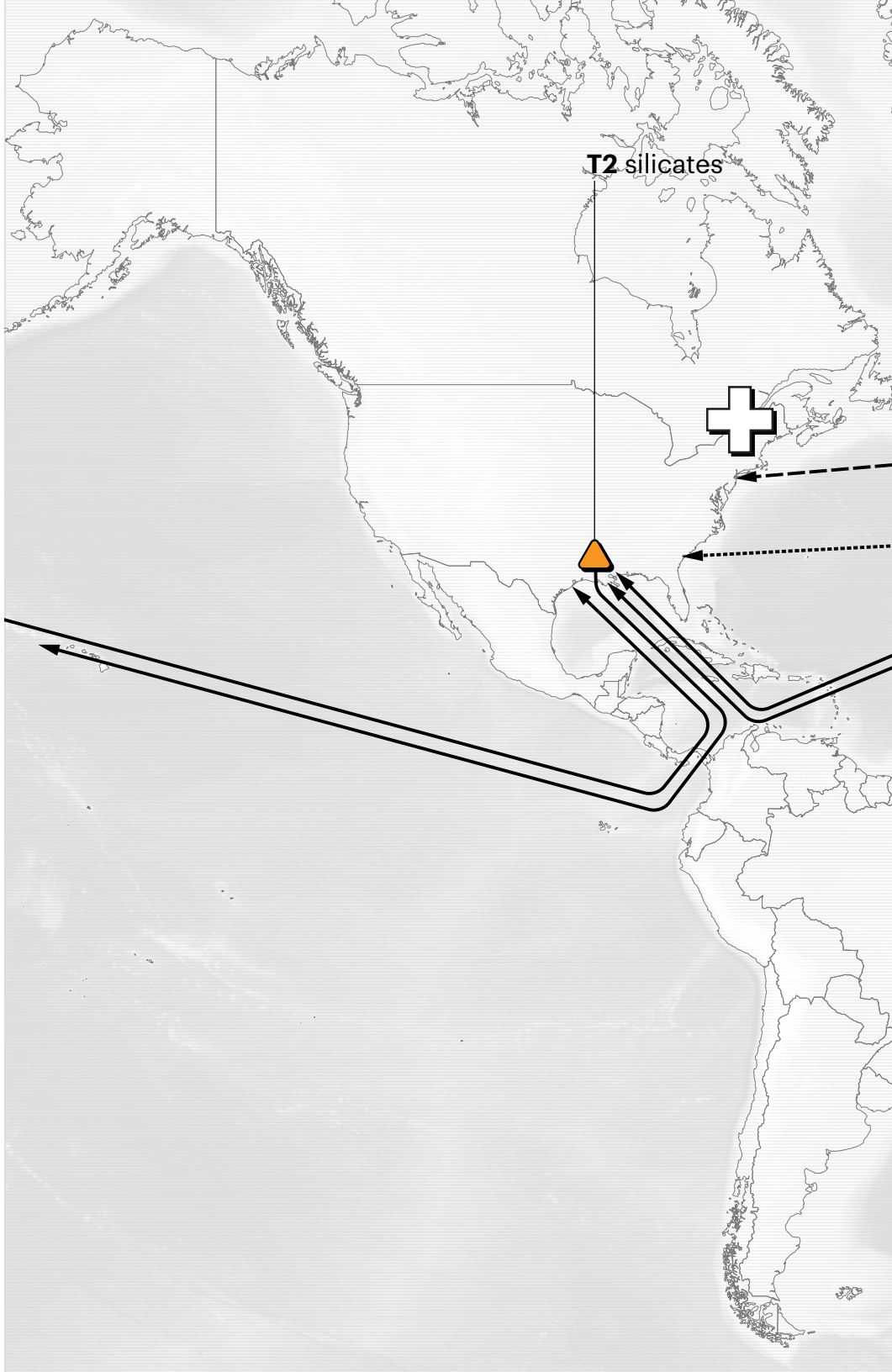
Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate



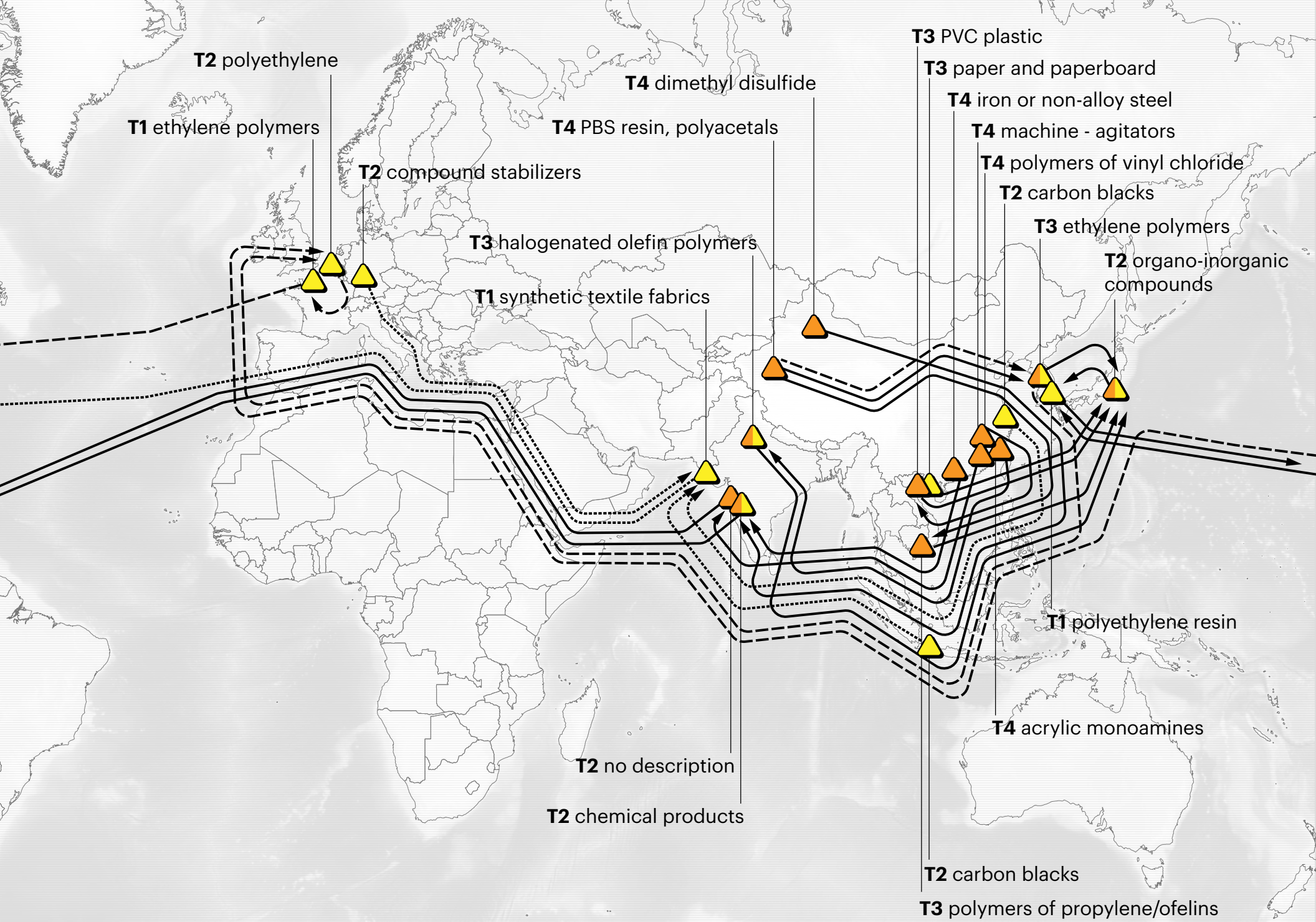
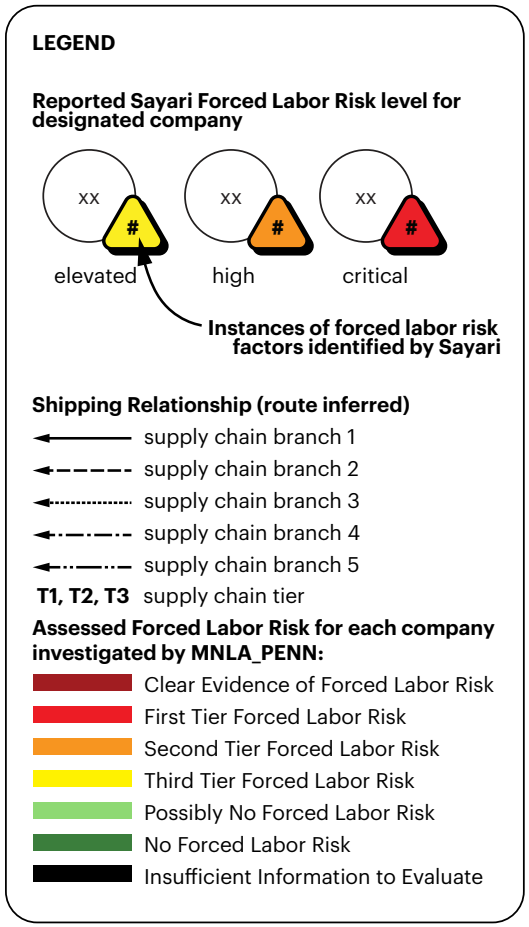


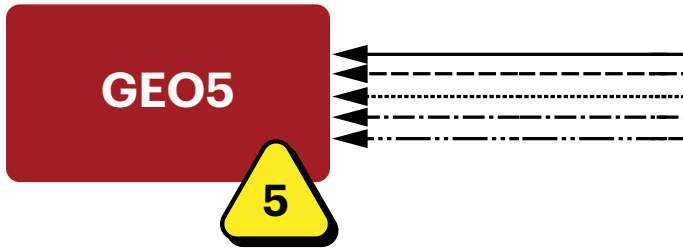
Figure 5.18, Shipping Map of Global Supply Chain Risk: GEO3, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

GEO5

This image is a partial mapping of GEO5's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





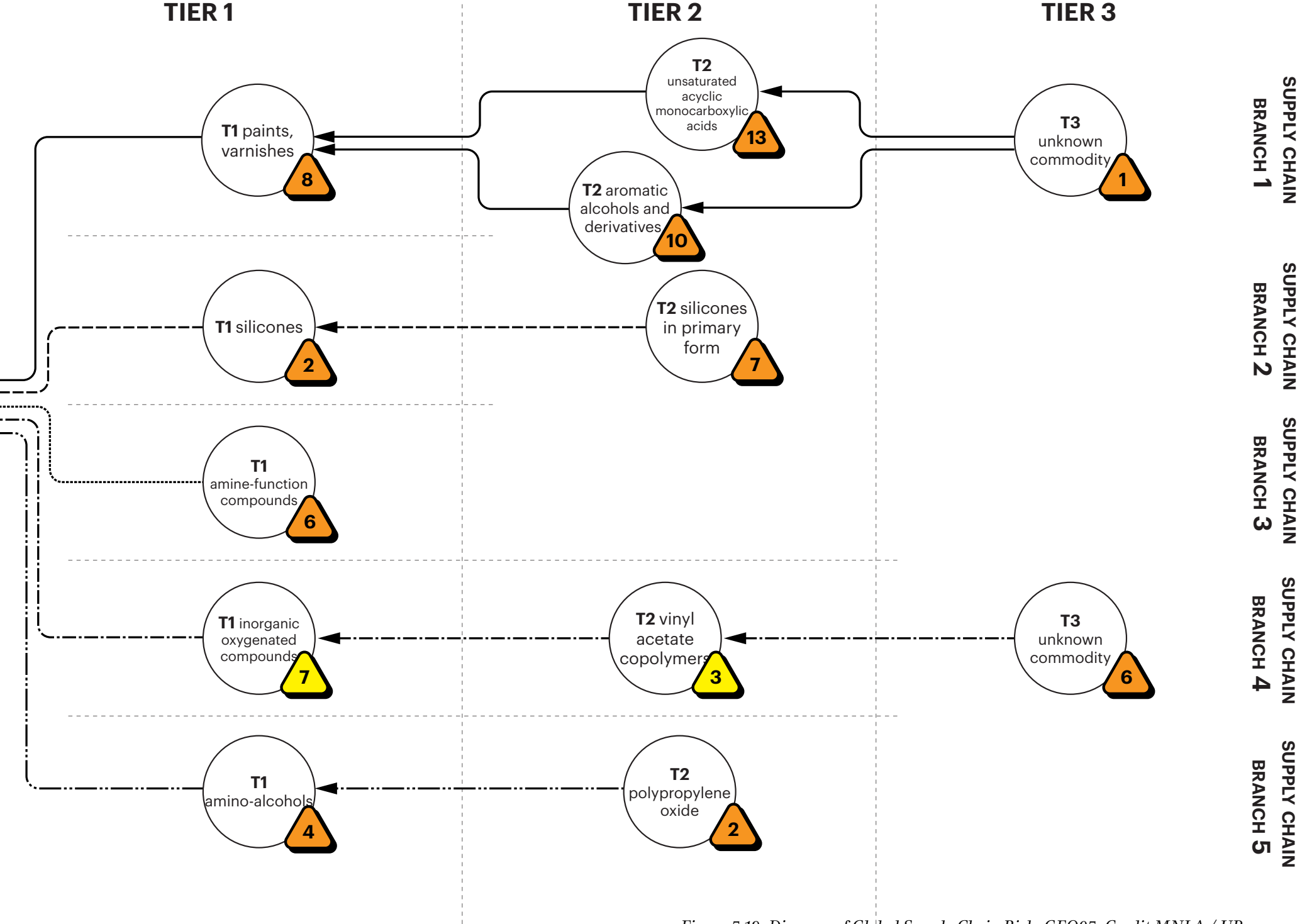


Figure 5.19, Diagram of Global Supply Chain Risk: GEO05, Credit MNLA / UPenn

Endnotes

[1] Charles W. Harris, *Time-Saver Standards for Landscape Architecture* 2E, (McGraw Hill, 2023): 880.1 – 880.8

[2] Fortune Business Insights, "Advanced Materials/Geotextiles Market," https://www.fortunebusinessinsights.com/geotextiles-market-105063

[3] Hasan, Redwanul. "An Overview of Geotextiles: Industrial Application in Technical Textiles." *Journal of Textile Science & Fashion Technology*. Iris Publishers. January 21, 2020.; Wu, Hao, Chongkai Yao, Chenghan Li, Miao Miao, Yujian Zhong, Yuquan Lu and Tong Lui. "Review of Application and Innovation of Geotextiles in Geotechnical Engineering." *Materials*. 2020; Mikhael, Elissar, Abdelmalek Bouazza, Will P. Gates, and Daniel Gibbs. "Are Geotextiles Silent Contributors of Ultrashort Chain PFASs to the Environment?" *Environmental Science & Technology*. 2024.

[4] Ibid.

[5] "Groupe Solmax acquires its biggest competitor in an award-winning deal," Montreal June 20, 2018, News Release, https://www.lacaisse.com/en/news/perspectives/groupe-solmax-acquires-its-biggest-competitor-award-winning-deal

[6] "Groupe Solmax acquires its biggest competitor in an award-winning deal," Montreal June 20, 2018, https://www.lacaisse.com/en/news/perspectives/groupe-solmax-acquires-its-biggest-competitor-award-winning-deal

[7] "Solmax, the world's leading geosynthetics manufacturer, acquires TenCate Geosynthetics," Montreal, April 7, 2021, News Release, https://www.lacaisse.com/en/news/pressreleases/solmax-worlds-leading-geosynthetics-manufacturer-acquires-tencate-geosynthetics. See also "Canada's Solmax completes acquisition of geosynthetics firm Propex,"*Fibre2Fashion*, December 13, 2021, https://www.fibre2fashion.com/news/technical-textiles/canada-s-solmax-completes-acquisition-of-geosynthetics-firm-propex-277864-newsdetails.htm; Dave Flessner, "After selling off carpet backing, concrete solutions, Chattanooga-based Propex is positioned for growth," *Chattanooga Times Free Press*, December 25, 2021 https://www.timesfreepress.com/news/2021/dec/25/propex-growth/

[8] "Solmax, the world's leading geosynthetics manufacturer, acquires TenCate Geosynthetics," Montreal, April 7, 2021, News Release, https://www.lacaisse.com/en/news/pressreleases/solmax-worlds-leading-geosynthetics-manufacturer-acquires-tencate-geosynthetics

[9] "Meet Solmax, a champion of the new Québec economy," Varennes, May 13, 2022, Article, https://www.lacaisse.com/en/news/perspectives/meet-solmax-champion-new-quebec-economy

[10] "Solmax collaborates with Tennet and SWITCH for recycling of geotextiles in energy projects in Europe", *Geosynthetic News* | March 25, 2024 | By: ATA https://geosyntheticsmagazine.com/2024/03/25/solmax-collaborates-with-tennet-and-switch-for-recycling-of-geotextiles-in-energy-projects-in-europe/

[11] "Solmax announces strategic consolidation of European nonwoven production facilities" *Geosynthetics Magazine*, December 4, 2024, https://geosyntheticsmagazine.com/2024/12/04/solmax-announces-strategic-consolidation-of-european-nonwoven-production-facilities/

[12] Sika AG, "Sika Acquires Renowned Construction Chemicals Company in Qatar", June 26, 2025 , https://uk.finance.yahoo.com/news/sika-acquires-renowned-construction-chemicals-050000842.html

[13] https://uk.finance.yahoo.com/news/ftse-100-share-soar-around-002700009.html

[14] Mary Baily, "Sika and Sulzer to establish plastics recycling JV for the construction sector" *Chemical Engineering*, June 3, 2025, online https://www.chemengonline.com/sika-and-sulzer-to-establish-plastics-recycling-jv/?printmode=1

[15] Sarthak Agarwal, "Sika unveils new plant in Kazakhstan," *Investment Monitor,* 9 April, 2025, https://www.investmentmonitor.ai/news/sika-unveils-new-plant-in-kazakhstan/

[16] "DuPont to sell Protective Coatings business to Sika" https://www.reliableplant.com/Read/3693/dupont-to-sell-protective-coatings-business-to-sika-

[17] SIKA AG, "Sika Acquires Renowned Construction Chemicals Company in Qatar," *GlobeNewswire*, June 26, 2025, https://uk.finance.yahoo.com/news/sika-acquires-renowned-construction-chemicals-050000842.html?guccounter=1

This page is intentionally left blank

5.3
SYNTHETIC TURF

East River Park Synthetic Turf Installation, Credit MNLA

SYNTHETIC TURF DETAIL

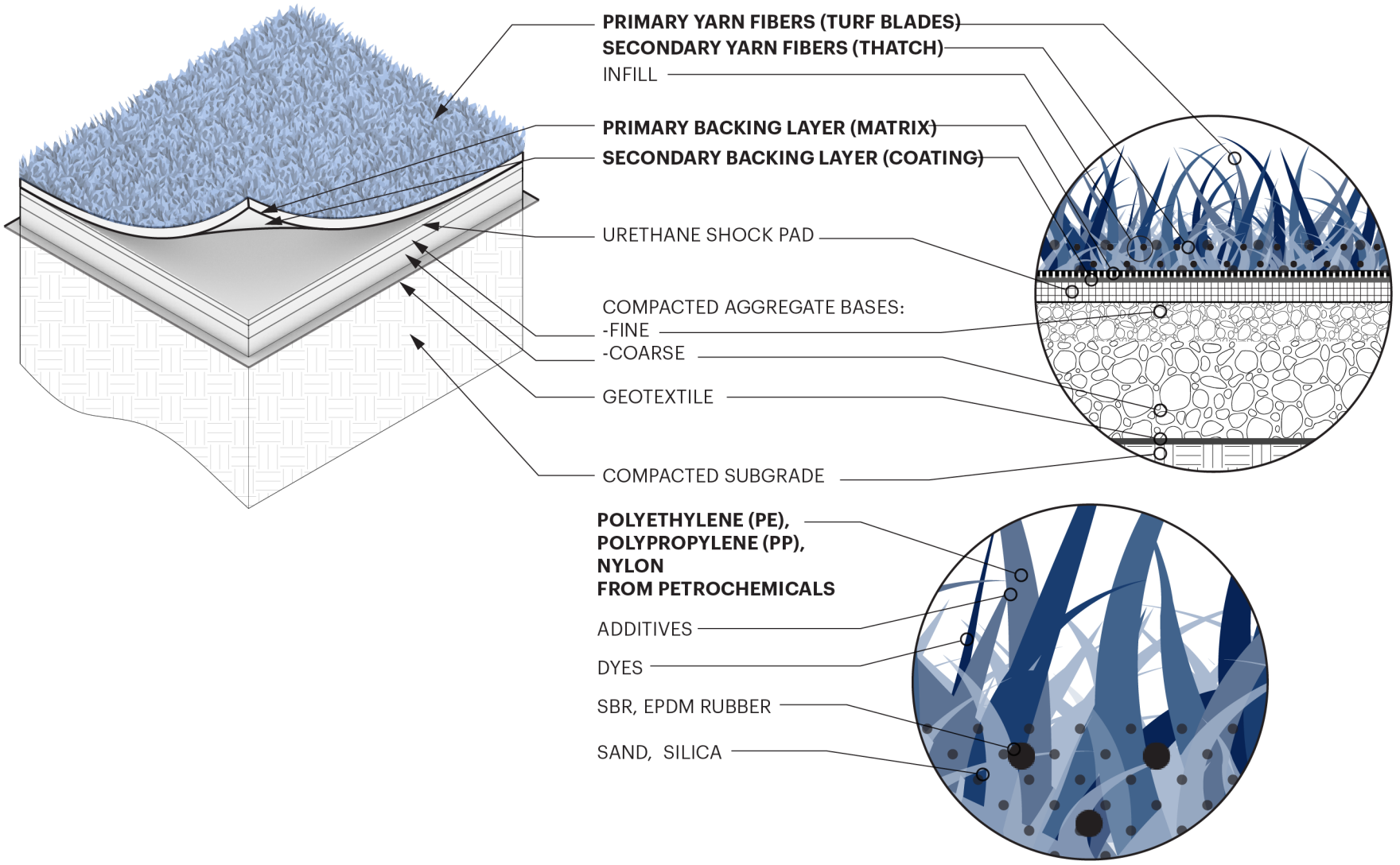


Figure 5.20, Synthetic Turf Detail, Credit MNLA

5.3 SYNTHETIC TURF

What is Synthetic Turf and why is it used?

In the United States, weekend sporting events would not be possible without the fabrication, installation, and consumption of synthetic turf. Both young children and seasoned professional athletes spend a great deal of time on pitches (fields) made of highly articulated plastic surfaces.

Synthetic turf (ST) is widely used in landscape architecture to provide a low-maintenance, durable, and consistent surface that mimics the appearance of natural grass. It is often selected for applications where real grass would be difficult or costly to maintain, due to high foot traffic or environmental constraints, such as public parks, sports fields, and playgrounds. Unlike natural turf (sod/grass), synthetic turf eliminates the need for irrigation, mowing, soil amendments, and seasonal grass regrowth. These practical benefits make it an attractive option in dense urban settings such as New York City, where long-term maintenance and water use are key concerns.

The use of synthetic turf, however, is not without its challenges or risks. Flooding, high temperatures on the turf, and particulate contamination have been repeatedly cited as concerns when using synthetic turf.

Material Composition and Manufacturing

Synthetic turf systems are composed of several layers, assembled into a "sandwich system." The visible surface consists of a turf carpet made up of:

- Primary yarn fibers (Turf 'blades'),
- Secondary yarn fibers ('Thatch' to add bulk and cushion),
- Infill
- Primary backing layer (Textile matrix) and
- Secondary backing (coatings)

The part of the assembly that is specified from other companies includes:

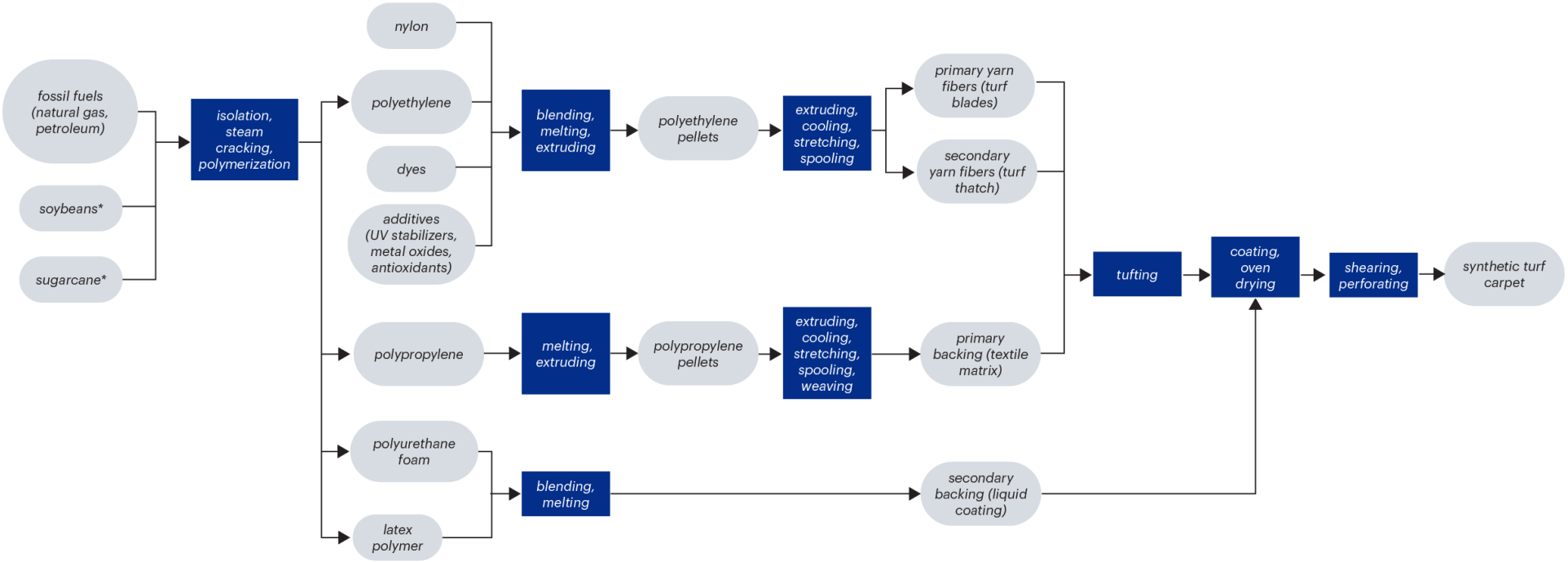
- Urethane Shock Pads
- Compacted Aggregate Bases
    1. Fine
    2. Coarse
    3. Geotextile
    4. Compacted Subgrade

Most components that make up synthetic turf originate from fossil fuel products, be they from petroleum or natural gas. The most used materials for yarn fibers and backing include polyethylene (PE), polypropylene (PP), and nylon. These plastics are synthesized through petrochemical refining and polymerization, and then blended with additives such as UV stabilizers, dyes, flame retardants, anti-microbials, and others, and made into plastic pellets. The additives enhance qualities such as durability, softness, and resistance to weathering.[1]

The next stage in the manufacturing process is extrusion, in which plastic pellets are melted and pushed through a die to form thin, continuous strands. These strands can take the form of monofilament fibers, which are individual blades designed to resemble natural grass, or slit-film (fibrillated) fibers, which begin as flat tapes and are slit into net-like patterns that separate into finer strips when installed. Once extruded, the fibers are cooled, stretched to increase tensile strength, and spooled in preparation for tufting.[2]

Figure 5.21, Synthetic Turf, Credit MNLA

SYNTHETIC TURF MATERIAL PROCESS DIAGRAM



Sample mapping of synthetic turf manufacturing process

**as reported by company ST2, some alternatives are being used to produce ethylene and polyethylene.*

New graphic based on content from:
https://astroturf.com/synthetic-turf-glossary-of-terms/
EPD for Artificial Turf Products from Fieldturf Tarkett
EPD for Stalok(r) SBR latex backing
EPD for Turf Flooring from Ecore International
Shaw Sportsturf and Shawgrass Product data sheets

Figure 5.22, Synthetic Turf Process Diagram, Credit MNLA

Tufting is the process by which the fibers are stitched into a primary backing fabric, often made of woven polypropylene, using machines that operate similarly to carpet manufacturing. This creates dense rows of upright "grass" held in place. To secure the fibers further, a secondary backing is applied as a coating of polyurethane or latex polymer adhesive, giving the turf greater stability and weather resistance. The carpet is sheared, and the backing is then perforated with drainage holes.[3]
Once the turf leaves the factory, it is installed in situ in a landscape project with infill materials that are spread between the turf blades to weigh the assembly down, to help with cushioning impacts, and to help the fibers stand upright. Infill types vary widely, ranging from synthetic latex/rubber alternatives such as recycled waste (tire) crumb rubber (Styrene Butadiene Rubber/SBR), and EPDM (Ethylene Propylene Diene Monomer), to hybrid options such as coated sand and silica, and organic alternatives like walnut shells, cork, and coconut fiber.

Additional components, such as shock pads and base layers, are often added to improve safety, drainage, and performance. The installation typically includes a geotextile membrane at the lowest layer of the installation.

Material and chemical updates in the turf industry are ongoing. Chemical additives are often incorporated into yarn fibers and/or infill to impart UV resistance, antimicrobial properties, anti-static behavior, or increased tensile strength. For example, the Sanitized® antimicrobial additive, used in Synlawn's EnviroLoc+ Biobased Backing Systems is made of a mixture of silver phosphate glass, silver nitrate, and silver chloride on a titanium dioxide carrier for the purpose of reducing the risk of Algae and Fungi.[4] However, the introduction of these additives, and other additives introduces new complexities into the material's composition, environmental profile, and supply chain. Additives not only alter the chemical profile of synthetic turf but also expand the network of material suppliers, intensify reliance on global chemical manufacturing, and make both environmental assessment and supply chain transparency more challenging.

Manufacturer Engagement and Data Access Challenges

To better understand the sourcing and chemical composition of synthetic turf, our team contacted seven (7) major manufacturers. The acronym we are using for this family of materials is ST for ST1, ST2, ST3 etc. In general, companies were not very responsive when asked to participate in our Manufacturer's Questionnaires.

- ST1 forwarded our Manufacturer Questionnaire to their legal team, but no response followed.
- Three companies (ST1, ST2, and ST4) initially offered to connect us with staff involved in material sourcing or testing. However, ST1 and ST2 ceased responding, and ST4 discontinued communication after initially confirming they had statements regarding PFAS and microfibers.

Due to the lack of transparency, or voluntary engagement, the team narrowed its focus to three companies, ST1, ST2, and ST7, for more targeted research. Legacy issues will be discussed as they pertain to ST6.

Figure 5.23, Synthetic Turf at Playground, Credit MNLA

Corporate Social Responsibility Profile

Despite repeated efforts, no Environmental Product Declarations (EPDs) or Health Product Declarations (HPDs) were made available by any of these companies.

Eight months after our first inquiry, a team member was finally able to secure a partial response from ST1 via LinkedIn, routed through their public relations firm. Although still no EPD was provided, the limited answers helped corroborate findings from third-party databases like Sayari.

FORCED LABOR RISKS FOR SYNTHETIC TURF

The Material in the News:

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component as ST1 to ST8)

Synthetic turf occupies a complex position in the urban landscape, for while it offers practical solutions for densely populated play surfaces, it has been the source of growing environmental concerns. It addresses maintenance and usability challenges in public spaces, yet its long-term environmental and health impacts remain insufficiently studied, poorly disclosed, and highly controversial. Some companies have demonstrated their sensitivity to public exposure and bad press, given the heightened scrutiny over the presence of PFAS in their products and the growing awareness of potential health risks.

Given the critical climate around the use of synthetic turf, some companies have reframed the product's benefits, claiming greater sustainability in requiring less water and lasting much longer than natural grass. However, recent flooding events have revealed the fragility of these installations when water sits and pools in low-lying, synthetic turf areas that do not drain.[5] In addition, all manner of flooding events contribute to runoff of the infill crumb/beads/particulates regardless of what material they are made of. If made of plastics, this also exacerbates the contamination of water runoff and groundwater.

Local communities and public health advocates

Local opposition to synthetic turf has been intensifying. In New York City (NYC), residents are protesting proposed installations in parks and schoolyards, citing concerns over human health, environmental degradation, and the displacement of real green space. In April 2024, neighborhood organizers mobilized parents and residents to protest plans by NYC Parks to install an artificial turf field in Bennett Park, citing widespread PFAS contamination concerns.[6] Over 300 residents signed and sent letters to city officials, and organized a public demonstration voicing their fears that children would be exposed to "forever chemicals" known to be carcinogenic.[7] One parent, Kyla Bennett of Public Employees for Environmental Responsibility, questioned, "How can they in good conscience put this stuff down knowing there's PFAS in it?"[8]

In February 2025, protestors gathered at NYC City Hall to call attention to wider environmental costs associated with synthetic turf.[9] In May 2025, the Children's Environmental Health Center at Mount Sinai released an official statement urging NYC to reconsider the use of artificial turf, especially in spaces designed for children.[10] Amongst key concerns they cited: the release of microplastics and PFAS (so-called "forever chemicals") that occurs during normal turf use and during storms; the inability to identify the chemical additives that are added to the products; the continued weathering of the turf and the ongoing breakdown of polymer fibers that increase levels of contamination both in the soil and in adjoining water bodies. As microplastics, they leach into the environment. Lastly, synthetic turf is a product that contributes to increased heat absorption, since the typical temperature on the surface of a synthetic turf is significantly higher than that of natural grass. This is often the cause of burns and skin irritations for those who play on it.

In 2024, in Ithaca, New York, the installation of a synthetic turf field was challenged by an environmental advocacy group that sued Cornell University for its decision to use this material in the construction of a new campus project. The group called for an Environmental Impact Statement (EIS) in advance of the project proceeding further.[11]

Regulatory and legal landscape in US municipalities and states

Synthetic turf is currently among the most controversial materials used by landscape architects. As noted, many companies are sensitive to public exposure and bad press, given the heightened scrutiny over the presence of PFAS in their products and the growing public awareness of potential health risks. Typically, PFAS (Per- and polyfluoroalkyl substances) are found in many types of artificial turf. They are introduced during the manufacturing process to help shape the grass blades, to prevent the blades from breaking, as well as to prevent the machine from malfunctioning during manufacturing.[12]

PFAS poses human health risks if absorbed by the skin, inhaled, or ingested. As reported by *The Guardian,*

> *"PFAS, or per- and polyfluoroalkyl substances, are a class of about 15,000 chemicals often used to make products resist water, stain, and heat. The compounds are linked to cancer, liver problems, thyroid issues, birth defects, kidney disease, decreased immunity, and other serious health problems."*[13]

For such reasons, a Bill was introduced in New York State aimed at regulating products with PFAS. For example, Senate Bill S187A, in the 2025-2026 Legislative Session, *"Prohibits the sale of certain products that contain regulated perfluoroalkyl and polyfluoroalkyl substances; and provides penalties*

for violations." [14] If this Bill is passed, this could impact the types of polymers used in synthetic turf.

Municipalities including New York City and Boston have considered or enacted restrictions on the use of synthetic turf, particularly in areas frequented by children such as playgrounds. Notably, in the State of New York, 2025 has been a busy legislative year. Senate Bill S6868, *"Prohibits the installation or replacement of synthetic turf at outdoor athletic fields and facilities owned or operated by municipalities or school districts in the state,*" and proposes a statewide ban on the use of synthetic turf containing toxic substances such as PFAS in public recreational areas.[15] In addition, Senate Bill S3797, seeks to establish testing, labeling, and reporting requirements for synthetic turf products to ensure public transparency about their chemical composition.[16] This Bill is in Committee and seeks the cessation of all synthetic turf installations, "*pending a comprehensive environmental and public health study.*"[17] Both Bills remain under review in the Environmental Conservation Committee at the time of writing. In the past, Senate Bill S5726 from 2013/2014 set out to "Regulate the Production of Synthetic Turf," by limiting the amount of lead per parts per million.[18] This Bill stayed in Committee Senate and was not passed.

In the State of New Jersey, the state has issued a six-page technical memorandum that explicitly addresses the PFAS in Artificial Turf. Issued in February 2023, the memorandum notes that there is

> "*growing concern about sources of PFAS to the environment, as reports have shown widespread levels of PFAS in soils, surface water, and groundwater at levels that could impact human health. It is with this in mind that the Division of Science and Research has reviewed current literature and related reports that may provide some information on the potential contribution of PFAS to the environment from the placement of artificial turf.*" [19]

On the West Coast, as early as 2010, the California Attorney General's Office, pursued legal action against synthetic turf manufacturers over health and environmental concerns.[20]

Sporting industry, FIFA and the 2026 World Cup

Professional football players are calling for the switch to natural grass. According to *The New York Times*, in 2023, following a series of high-profile injuries and reports detailing a higher incidence of injuries when playing on synthetic turf, a call for natural grass has taken hold amongst those whose livelihood and professional careers are predicated on the ability for them to remain injury-free.[21]

FIFA (The International Football Federation) has traditionally required natural grass fields for World Cup soccer matches. This is what the players have preferred, even as many pitches in North American stadiums are made of synthetic turf. For the 2026 World Cup tournament, which is being held in the U.S., Mexico, and Canada, the organization claims it is supporting the development of a hybrid artificial-natural grass system. Throwing more technology at the problem, as reported by NBC News, "*With World Cup looming, these scientists are trying to create the perfect grass*," is needed because US venues must be serviceable after the games for other stadiums clients.[22] As a result, FIFA is also making an accommodation to allow a set of matches to be played on artificial turf due to the logistical challenge of maintaining natural turf in large stadiums with tight game schedules and varying climates.[23]

This policy change for FIFA raises key questions: Why now, after decades in which natural grass was the preferred material for matches? Did US stadium managers lobby for this accommodation, given that without it, it would cost them a great deal of money to alter their stadium for this event? In what way was the synthetic turf industry involved in the lobbying efforts? After all, if synthetic turf is not part of the 2026 FIFA World Cup games, this offers them little opportunity for leveraging the games for the purposes of advertising. This globally broadcast event is an important marketing opportunity for synthetic turf companies.

But how do the players (both professional and amateur) feel about the use of synthetic turf? As reported by *The Guardian*, athletes are prone to having "*higher levels of PFAS after play on artificial turf,*"[24] and as signaled by the *Philadelphia Inquirer,* synthetic turf may have been the possible source of a higher incidence of brain cancer amongst six baseball players from the Philadelphia Phillies.[25] Indeed, Philadelphia has been at the center of an additional turf war given the criticism levied by South Philadelphians (Friends of FDR Park) against its use for the refurbishment of Franklin D. Roosevelt Park. *The Philadelphia Inquirer* invited three companies (FieldTurf, Shaw Sports Turf, and Sprinturf) to submit samples so that they could be independently tested for their PFAS-free claims, but none of them replied to the invitation.[26] Community groups in Philadelphia have sued the city against the use of this material for these playgrounds.[27]

Industry's response

The Synthetic Turf (ST) industry is notoriously litigious. Mergers, acquisitions, and lawsuits are commonplace. A notable example is the company Polyloom, which filed a lawsuit in 2024 against a group of academic researchers, accusing them of defamation and tortious interference. In association with a number of other polymer-based companies that produce products for landscape design (such as TenCate Grass), Polyloom sued 4 four researchers for defamation who were set to host a seminar in January 2025 on the potential health risks of using this material in playgrounds and sports fields.[28] The free national webinar was scheduled for January 23, and titled "The Trouble With Turf."[29] Four scientists and public health officials discussing accepted science was threatening to those in the business of synthetic turf. The defendants were seeking to have a public discussion about the potential risks of having PFAS materials in synthetic turf. In response, Polyloom deployed all levers available to large corporations to silence their critics and to quell all public conversation about the hazards of using this product. The researchers, alongside Grassroots Environmental Education, counter-sued with an anti-SLAPP suit in New York State court, claiming that they are being unjustly targeted.[30]

TenCate Americas is also signatory to the lawsuit. As reported by *The New York Times*, on June 17th, 2025, "*Joe Fields, chief executive of TenCate Americas, part of the Dutch textiles and chemicals conglomerate that owns Polyloom, declined to discuss the lawsuit.*"[31]

In addition, with regards to their products in synthetic turf industry, TenCate is in court for trade secret violations, standing accused by competitor Field Turf.[32] TenCate Americas (in coordination with Polyloom Corp of America) has also filed federal lawsuits against a Chinese company (Qingdao Bellinturf) for patent infringements.[33] Additionally, Polyloom has been involved in a series of lawsuits over the years including "Polyloom Corporation of America v. Farrant et al"[34], "FieldTurf USA Inc. et al v. TenCate Thiolon Middle East, LLC et al"[35]. and "Polyloom Corporation of America d/b/a TC Thiolon USA v. Bellin Outdoor Living Inc."[36] The industry has been, and continues to be, subject to litigious activity.

Given the persistent lack of material transparency, mounting community pressure, pending legislation, and labor and human rights concerns, the role of synthetic turf in future urban landscapes is increasingly uncertain. Designers and decision-makers may need to fundamentally rethink how we build for durability, play, and ecological health, centered not just on performance, but on accountability and justice.

What does Sayari reveal?

Of all materials investigated during this LAF grant, Synthetic Turf has occasioned the most notoriety and troublesome press given its environmental and health related issues. Data collected via Sayari, also reveals troubling, forced labor issues embedded within the synthetic turf supply chain.

Most companies we reviewed scored in the (Red or Dark Red) categories, indicating the highest levels of risk for forced labor in their supply chains. For the most part this is because their source materials are synthesized polymers originating in regions of the world identified with high risk for forced labor. These risks are typically concentrated at the early stages of the supply chain, often at sites of raw material extraction and during the chemical processing stages required to manufacture the base polymers used in turf components.

These findings add a critical dimension to the ethical and social costs of specifying this material. It is notable, that given the synthetic polymer origins of this product and its fabrication using industrial weaving technology, several companies in this space also manufacture of other forms of flooring, including indoor flooring products and other landscape materials such as geotextiles and safety surface. Mergers and buyouts are common, and the ownership terrain changes with some frequency.

Some companies have third and fourth tier suppliers cited as part of the 2023 Sheffield Hallam report on the PVC flooring industry, companies whose US divisions have been working to reduce their risk, and/or to mitigate their apparent risk. This can be achieved by altering the origin of their supply chains away from the Xinjiang region of China or diverting their shipments to an intermediate country (such as Vietnam) that further distances the US company from direct receipt of products from Xinjiang.

More specifically, this is the risk profile of the companies we assessed:

- ST3, has insufficient information on Sayari and hence no evaluation can be made at this time for its risk of forced labor.

- ST2, is a company with many subsidiaries and affiliated companies whose relationships are identifiable via Sayari. One of these subsidiaries has the greatest amount of trade data available in Sayari. At this time, this company does not itself indicate direct exposure to forced labor risk, however, three of its first-tier suppliers do. They indicate Elevated Forced Labor risks of either [2] or [4]. Each of these first-tier suppliers receive goods from companies with both Elevated and High Forced Labor Risks. Another of ST2's first-tier suppliers is supplied by four companies at risk, three of which are at High Forced Labor Risks of [3], [11], and [13], respectively. One of which receives products from the Xinjiang region of China.

- ST4, is also as a company which at this time does not indicate direct exposure to forced labor risk in Sayari, however, two of its first-tier suppliers do. Both indicate Elevated Forced Labor risks of [2], while their suppliers indicate higher risks, of Elevated Forced Labor risks of [7], and High Forced Labor risks of [11], both which are sourced by same upstream companies which receives products from the Xinjiang region of China identified for ST2.

- ST6, see their evaluation under the category of Safety Surface (SS4). This company earlier in the year, was previously identified by Sayari as being at direct risk of forced labor.

- ST1, is a large sized building material company focused on flooring of all kinds for use in interiors as well as exteriors. It has many subsidiaries and affiliated companies whose relationships are identifiable via Sayari. The parent company is identified in Sayari as being at direct Elevated Forced Labor risk of [2]. Alongside the five interrelated companies that all belong to ST1, it has been the subject of many newsworthy stories including industry related performance lawsuits. The parent company was also directly identified in (2023) for forced labor risk in the Sheffield Hallam report, "Built on Repression," given their supply chain indicated procurement from the Xinjiang region. This company's synthetic turf division is no less at risk given that four separate first-tier supply chains, from which they import materials into the US, are at an Elevated Forced Labor risk. In the case of one supply chain, the risk of force labor is directly related to the sourcing of upstream materials from the same purveyors in the Xinjiang region as ST2 and ST4.

- ST5, is a company with many subsidiaries and affiliated companies whose relationships are identifiable via Sayari. One of these subsidiaries has the greatest amount of trade data available in Sayari and it too is a company at direct Elevated Forced Labor risk of [2]. Two of its first-tier suppliers are also at risk, with one of the two being significantly riddled with the highest level of risks. ST5 has five second tier suppliers with High Forced Labor risks, one chain of which is directly related to the sourcing of upstream materials from the same purveyors in the Xinjiang region as ST1, ST2, and ST4.

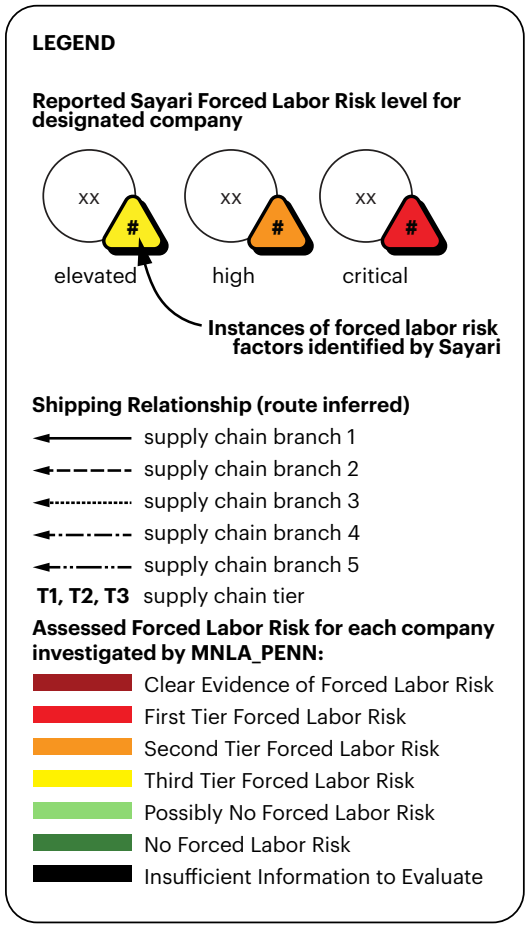
- ST7, is a large player in the space of synthetic turf. It is a company identified by Sayari at direct Elevated Forced Labor risk of [2]. In addition, six of its first-tier companies are at Elevated Forced Labor risks. One, has thirteen suppliers with Elevated and High Forced Labor risks ranging from [1] to [8]. In this case, two separate supply chains for ST7 are directly related to the sourcing of upstream materials from the same purveyors in the Xinjiang region as ST1, ST2, ST4, and ST5.

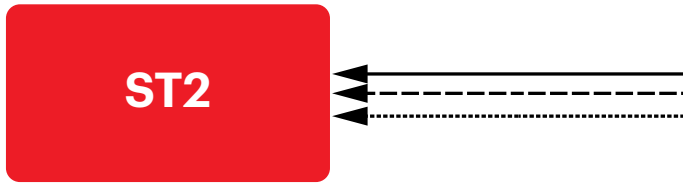
- ST8, is also as a company at direct risk of forced labor as identified by Sayari. It is identified with an Elevated Forced Labor risk of [2], while four of its first-tier suppliers are assessed with Elevated Forced Labor risks; three of which have continued High Forced Labor risks across their second and third tier suppliers.

Diagram of Global Supply Chain Risk

ST2

This image is a partial mapping of ST2's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





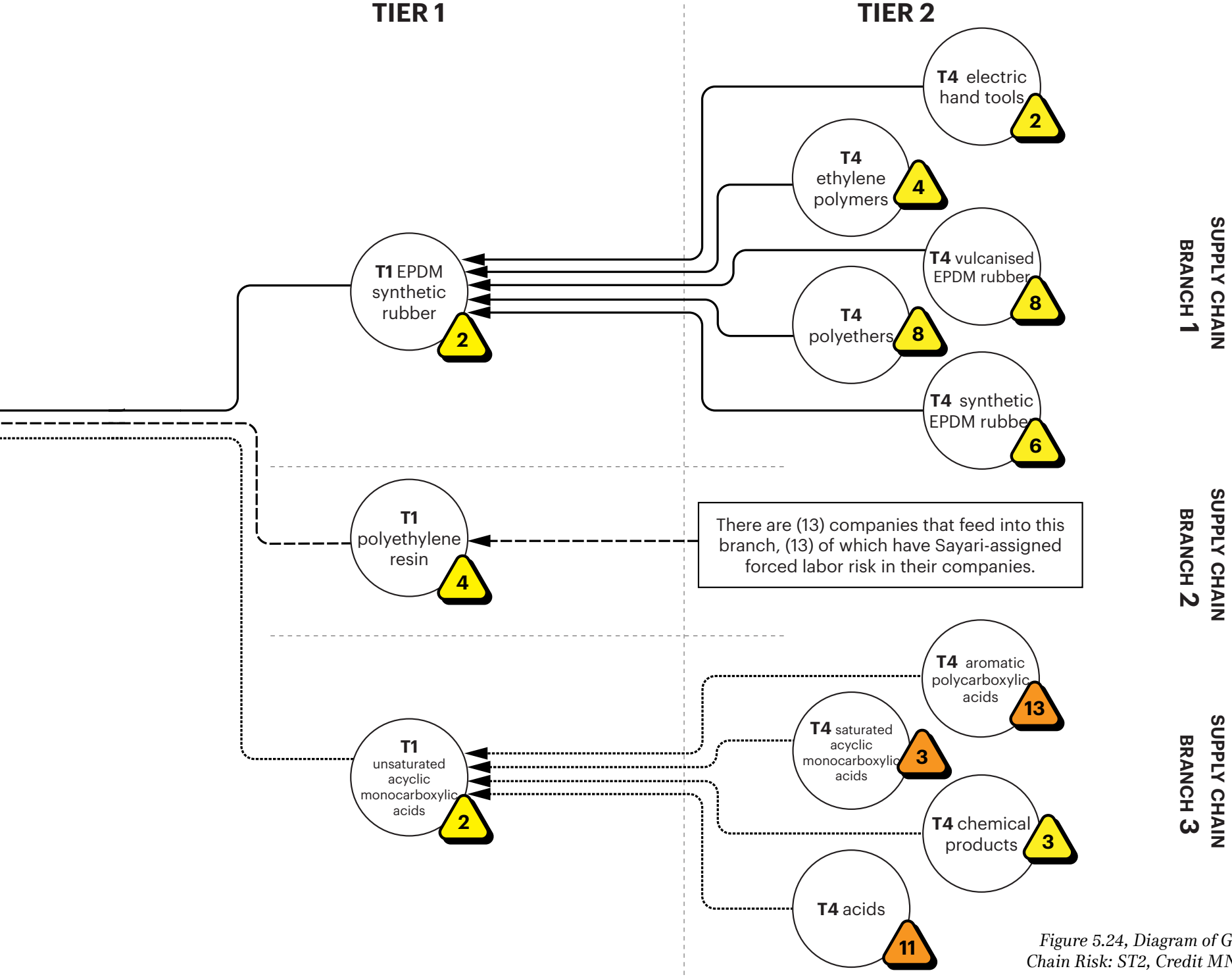
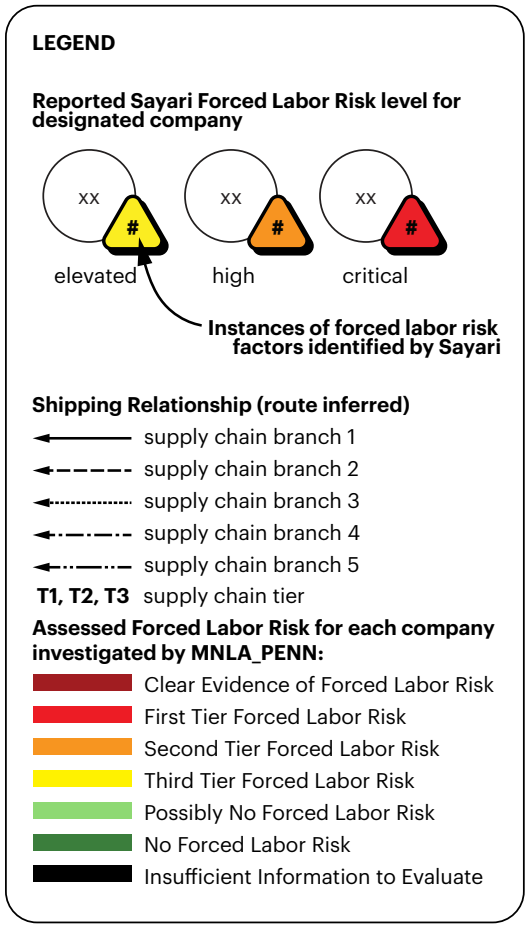


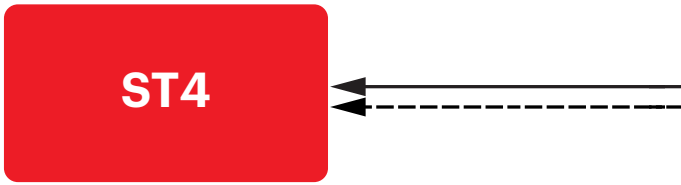
Figure 5.24, Diagram of Global Supply Chain Risk: ST2, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

ST4

This image is a partial mapping of ST4's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





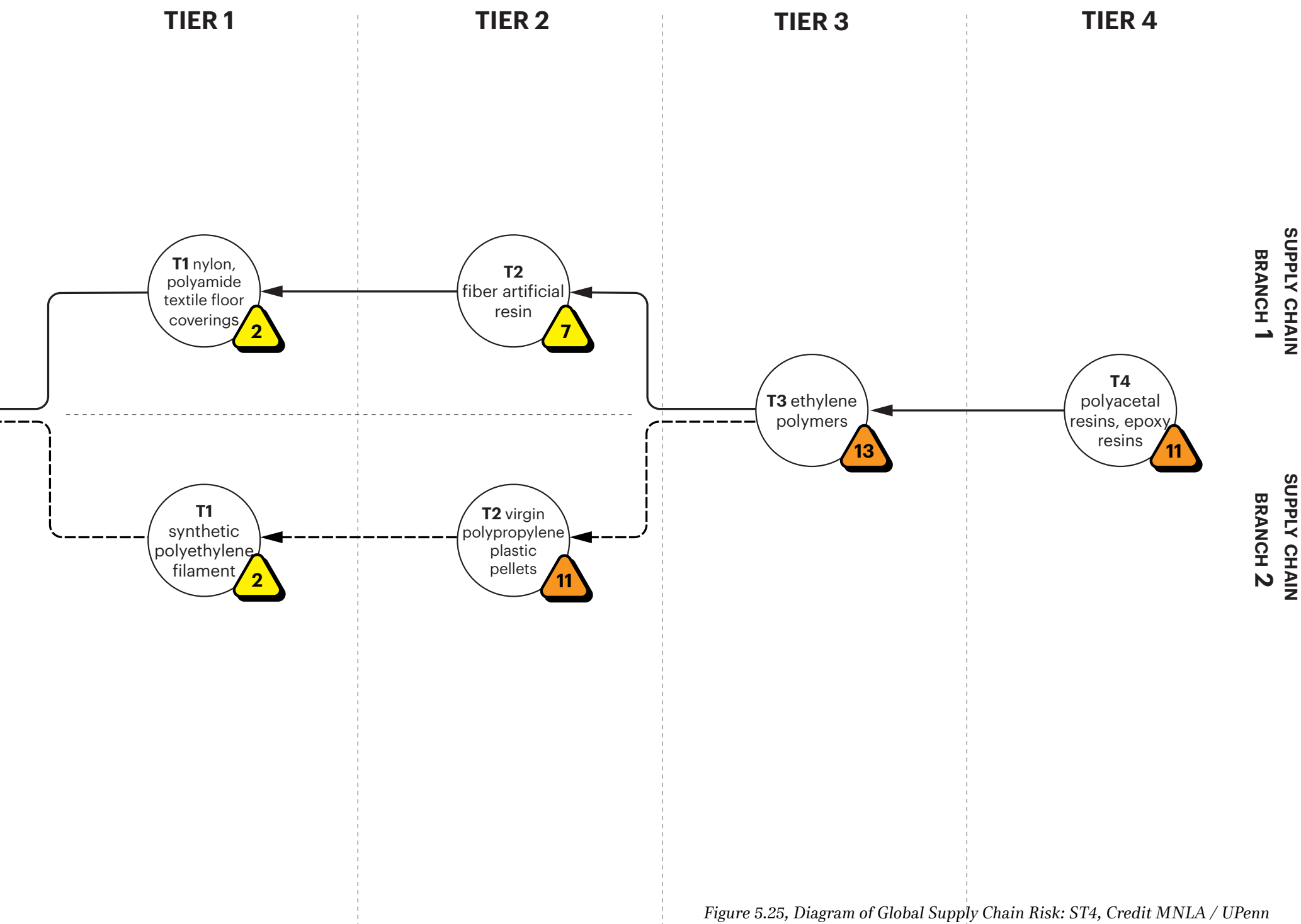
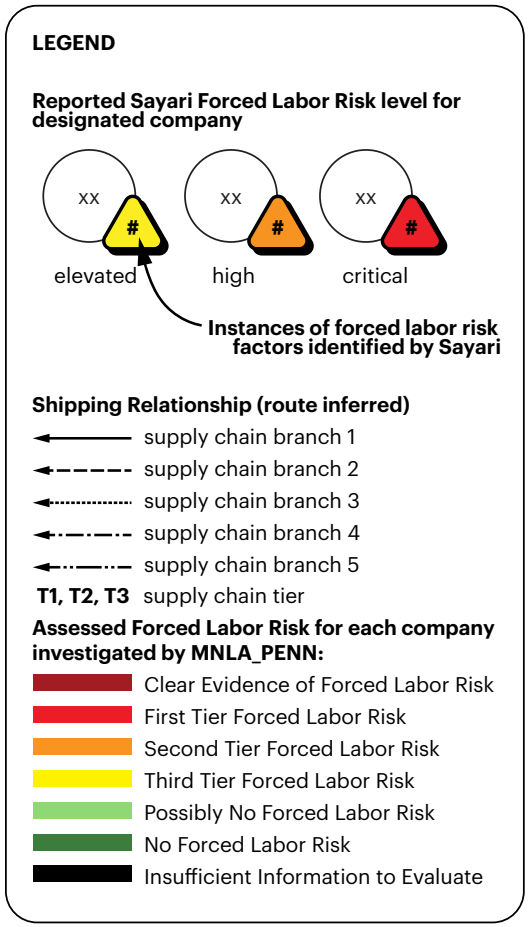


Figure 5.25, Diagram of Global Supply Chain Risk: ST4, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

ST1

This image is a partial mapping of ST1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.



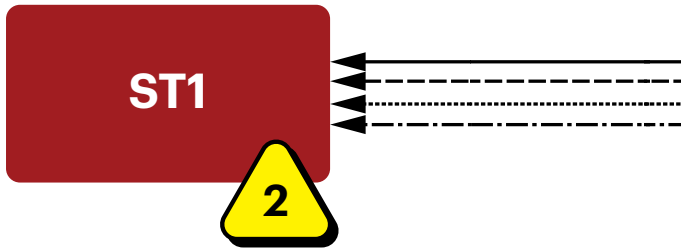
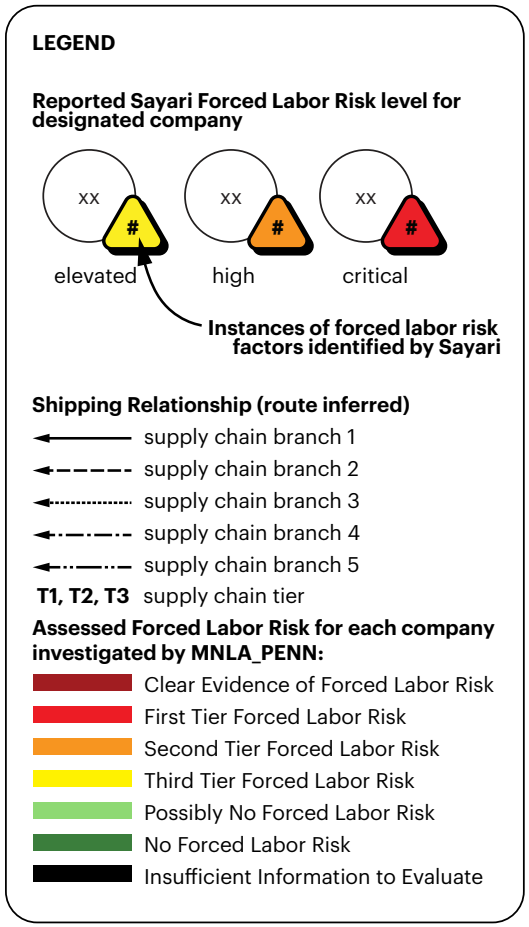


Figure 5.26, Diagram of Global Supply Chain Risk: ST1, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

ST5

This image is a partial mapping of ST5's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.



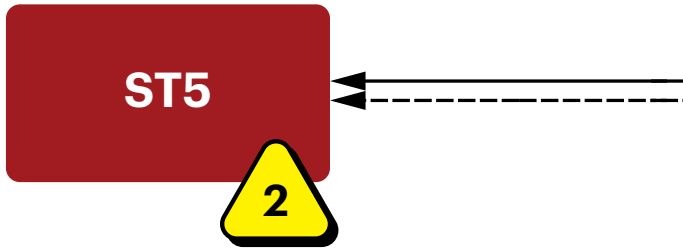


Figure 5.27, Diagram of Global Supply Chain Risk: ST5, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

ST1

This image is a partial mapping of ST1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate

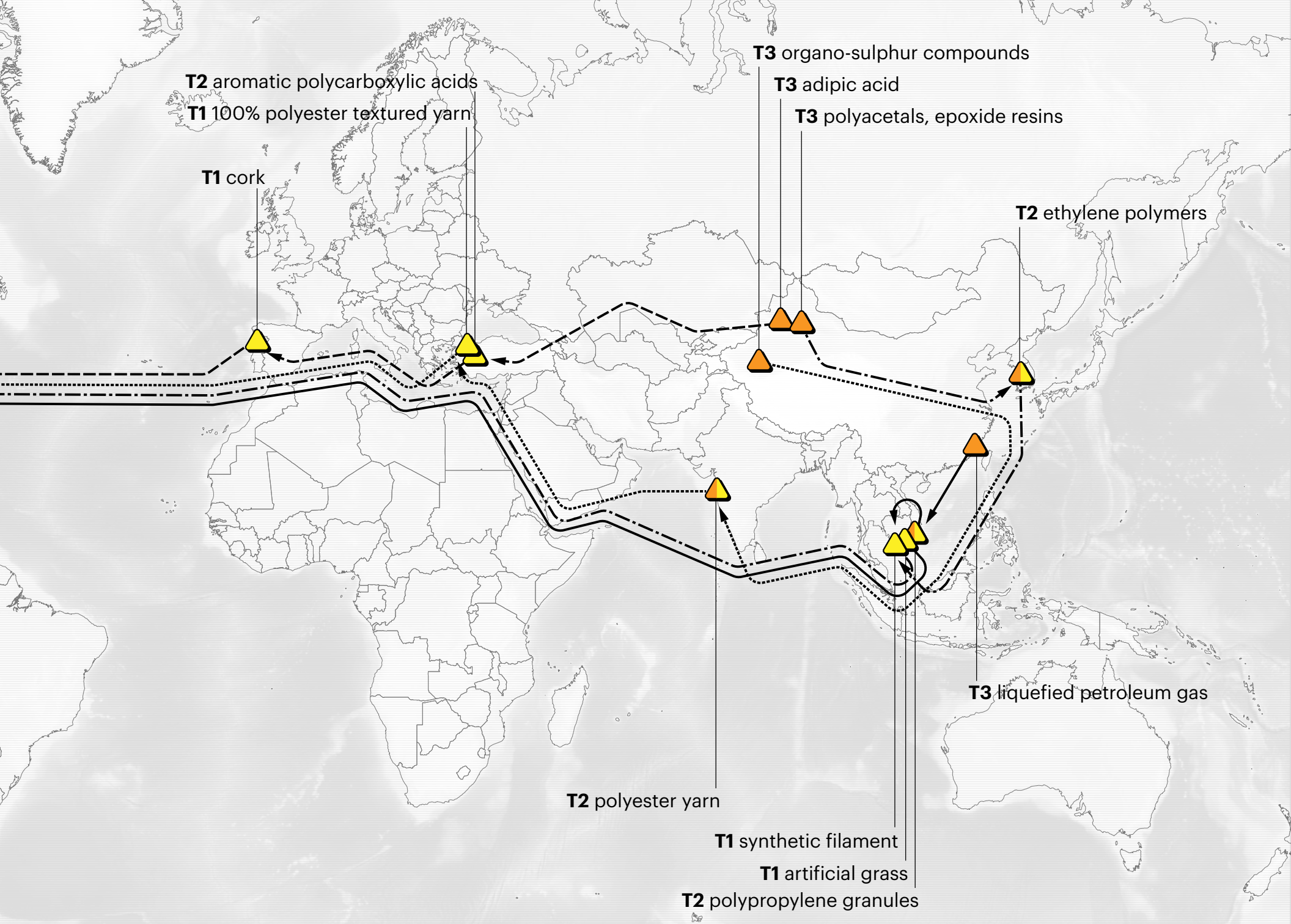
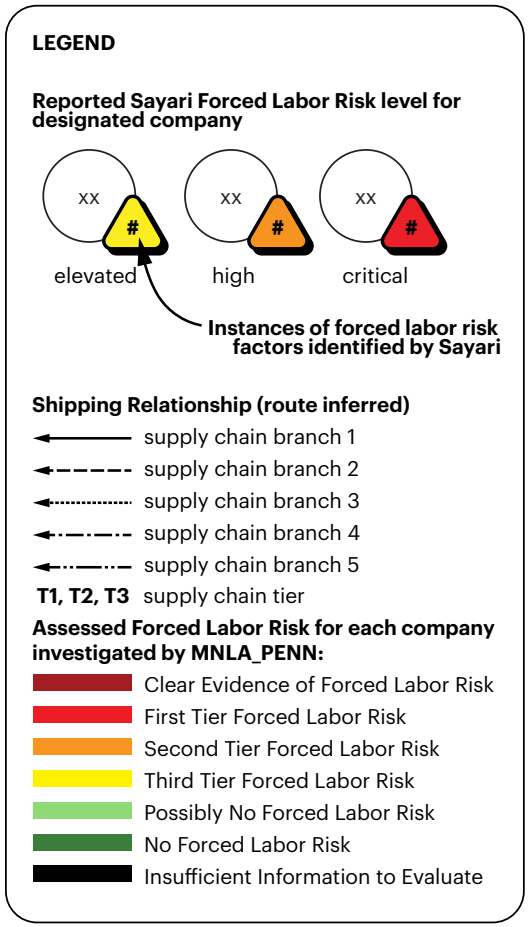


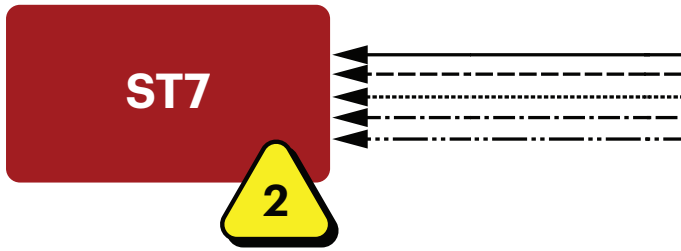
Figure 5.28, Shipping Map of Global Supply Chain Risk: ST1, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

ST7

This image is a partial mapping of ST7's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





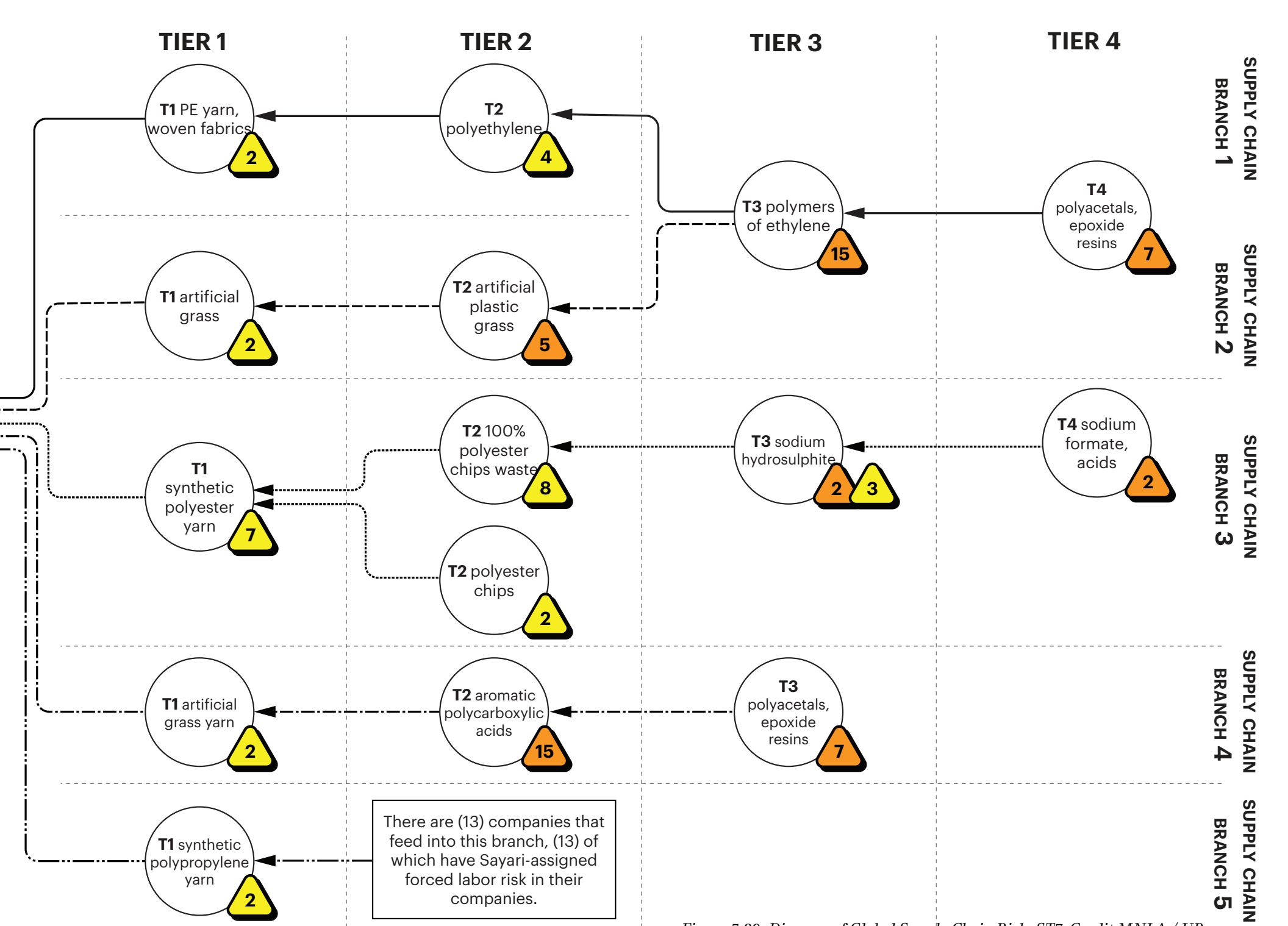


Figure 5.29, Diagram of Global Supply Chain Risk: ST7, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

ST7

This image is a partial mapping of ST7's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

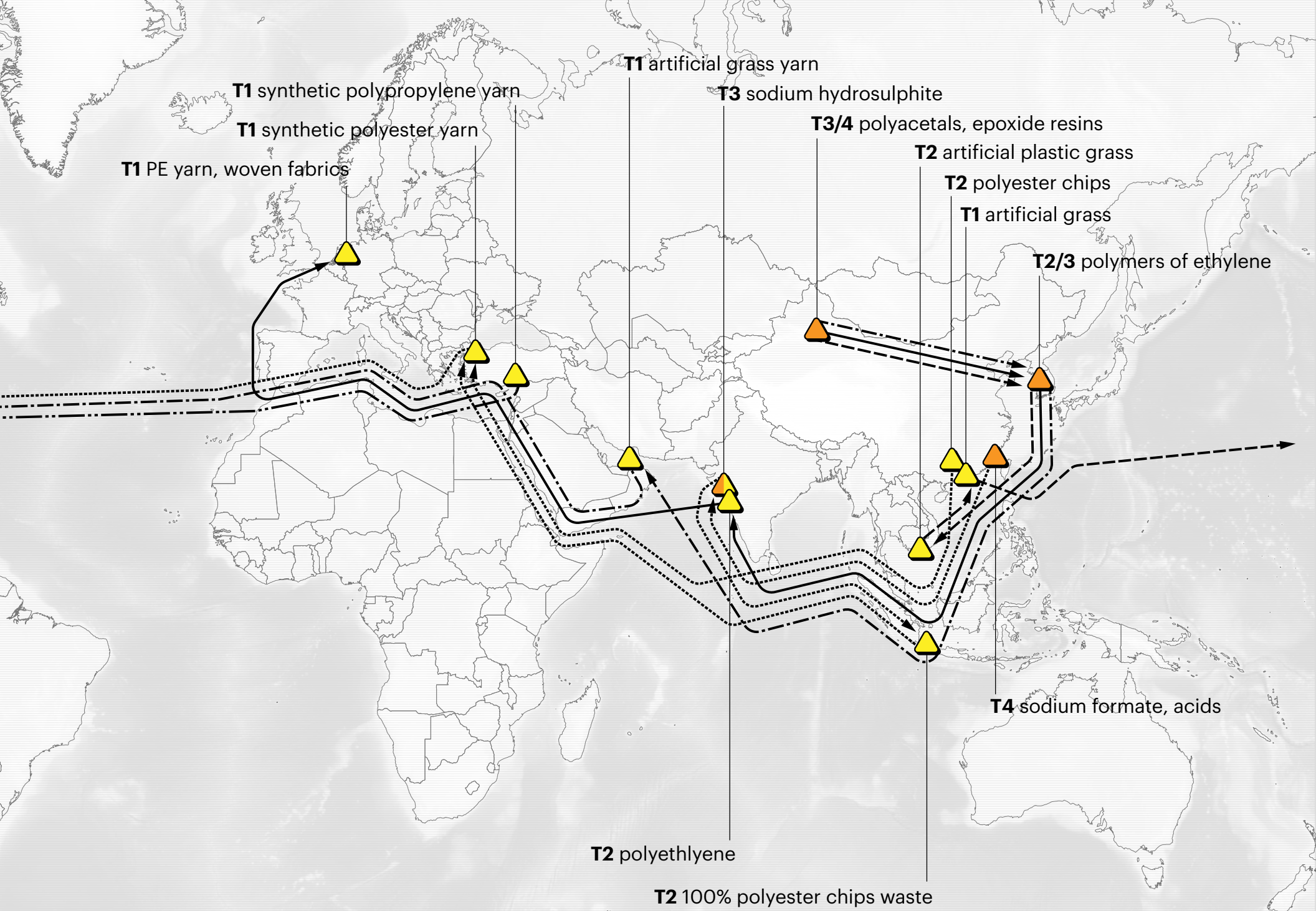
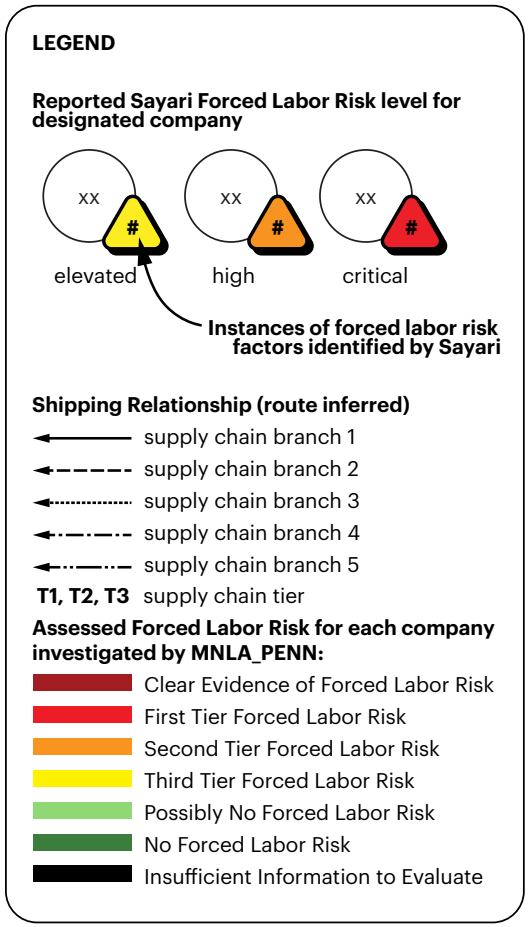


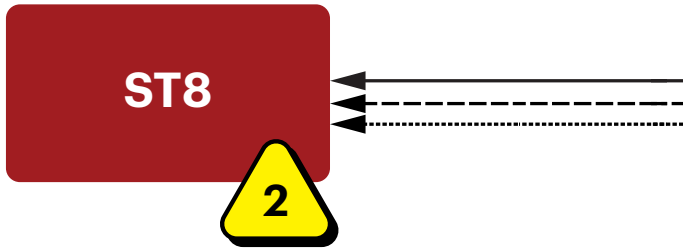
Figure 5.30, Shipping Map of Global Supply Chain Risk: ST7, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

ST8

This image is a partial mapping of ST8's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





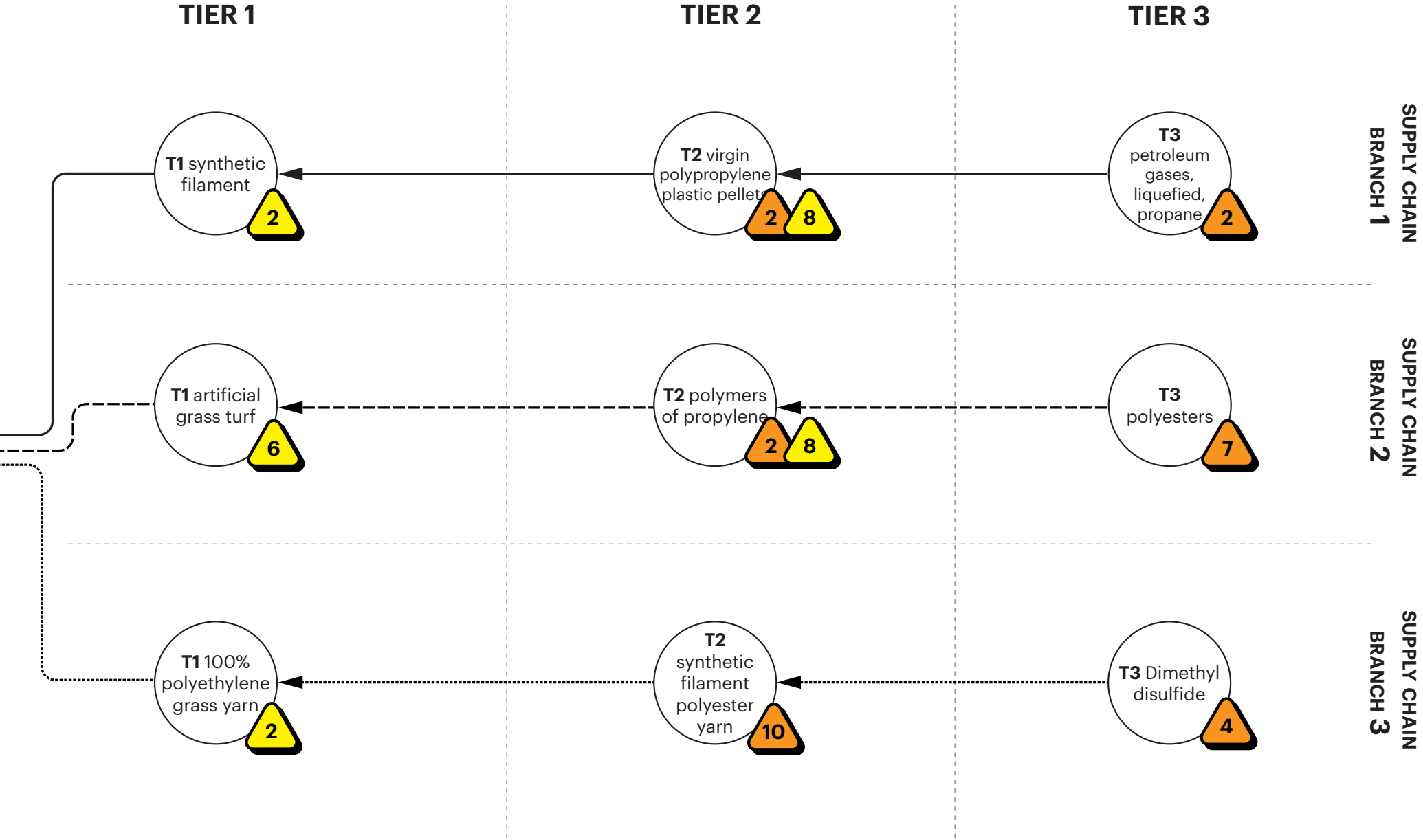


Figure 5.31, Diagram of Global Supply Chain Risk: ST8, Credit MNLA / UPenn

Endnotes

[1] Charles W. Harris, *Time-Saver Standards for Landscape Architecture 2E*, (McGraw Hill, 2023): 320-23, 440-2, 440-3.

[2] See the following resources: Company content: https://astroturf.com/synthetic-turf-glossary-of-terms/; EPD for Artificial Turf Products from Fieldturf Tarkett; EPD for Stalok(r) SBR latex backing; EPD for Turf Flooring from Ecore International; Shaw Sportsturf and Shawgrass Product data sheets. See also New York State, Department of Health, "Information About Crumb-Rubber Infilled Synthetic Turf Athletic Fields," https://www.health.ny.gov/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/fact_sheet.htm#:~:text=This%20first%20generation%20of%20synthetic,square%20foot%20of%20field%20surface; McNitt, A. S. "Synthetic turf in the USA–trends and issues." *International Turfgrass Society Research Journal* 10 (2005): 27-33, https://journals.sagepub.com/doi/abs/10.1177/1941738118793378; Orofino, T. A., and J. W. Leffingwell. "Selection of Materials for Artificial Turf." *Natural and Artificial Playing Fields: Characteristics and Safety Features* 1073 (1990): 166, https://books.google.com/books?hl=en&lr=&id=DXv2aikMmpkC&oi=fnd&pg=PA166&dq=artificial+turf+manufacturing+polyethylene&ots=OxrWVptGCv&sig=LDr1mCFd6ay546BIK6yoPTXa-Ts#v=onepage&q&f=false

[3] Ibid.

[4] Synlawn Brochure, Enviroloc+™ Backing System Truly 'Green' Technology, see https://www.synlawn.com/green-technologies/enviroloc/; https://www.synlawn.ca/enviroloc-backing-system/: 4-6; https://urldefense.com/v3/__https://www.sanitized.com/silver/: 1.

[5] Wirecutter, "Why We Don't Recommend Artificial Grass for Most People" *The New York Times*, July 9, 2021, https://www.nytimes.com/wirecutter/reviews/best-artificial-grass/

[6] Samantha Maldonado, "An Actual Turf War Erupts in Washington Heights as Parents Protest Synthetic Grass" in *The City, Reporting to New Yorkers*, April 4, 2024 https://www.thecity.nyc/2024/04/04/artificial-turf-war-washington-heights-pfas/?utm_source=chatgpt.com

[7] Massey R, Pollard L, Jacobs M, Onasch J, Harari H. "Artificial Turf Infill: A Comparative Assessment of Chemical Contents," *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*. 2020;30(1):10-26. doi:10.1177/1048291120906206

[8] Samantha Maldonado, "An Actual Turf War Erupts in Washington Heights as Parents Protest Synthetic Grass" in *The City, Reporting to New Yorkers*, April 4, 2024 https://www.thecity.nyc/2024/04/04/artificial-turf-war-washington-heights-pfas/?utm_source=chatgpt.com

[9] Katherine Donlevy, "Protesters demand ban on artificial grass in NYC public parks, which they say will poison kids with 'forever chemicals'", *The New York Post*, February 27, 2025. https://nypost.com/2025/02/27/us-news/protesters-outside-city-hall-demand-ban-on-artificial-grass-in-public-parks/

[10] Valeria Menendez, "Position Statement on the Use of Artificial Turf Surfaces" Icahn School of Medicine at Mount Sinai, May 29, 2025. https://mountsinaiexposomics.org/position-statement-on-the-use-of-artificial-turf-surfaces/

[11] Fernando Figeuroa, "Environmental group sues to pause Cornell fieldhouse project over turf concerns", *The Ithaca Voice*, November 22, 2024. https://ithacavoice.org/2024/11/environmental-group-sues-to-pause-cornell-fieldhouse-project-over-turf-concerns/

[12] Samantha Maldonado, "An Actual Turf War Erupts in Washington Heights as Parents Protest Synthetic Grass" in *The City, Reporting to New Yorkers*, April 4, 2024 https://www.thecity.nyc/2024/04/04/artificial-turf-war-washington-heights-pfas/?utm_source=chatgpt.com, and Tom Perkins, "Athletes likely to have higher levels of PFAS after play on artificial turf – study", *The Guardian*, March 15, 2024.

[13] Tom Perkins, "Athletes likely to have higher levels of PFAS after play on artificial turf – study", *The Guardian*, March 15, 2024, https://www.theguardian.com/environment/2024/mar/15/athletes-higher-pfas-levels-artificial-turf#:~:text=All%20artificial%20turf%20is%20made%20with%20what,inhaled%2C%20ingested%20or%20get%20in%20open%20wounds

[14] New York State Senate, Senate Bill S187A, 2025-2026 Legislative Session," Prohibits the sale of certain products that contain regulated perfluoroalkyl and polyfluoroalkyl substances; and provides penalties for violations", https://www.nysenate.gov/legislation/bills/2025/S187/amendment/A#:~:text=2025%2DS187%20%2D%20Summary,distribution%3B%20provides%20penalties%20for%20violations

[15]New York State Senate, Senate Bill S6868, 2025-2026 Legislative Session, "Prohibits the installation or replacement of synthetic turf at outdoor athletic fields and facilities owned or operated by municipalities or school districts in the state," https://www.nysenate.gov/legislation/bills/2025/S6868

[16] New York State Senate, Senate Bill S3797, 2025-2026 Legislative Session, "Establishes a moratorium on the installation of synthetic turf pending a comprehensive environmental and public health study," https://www.nysenate.gov/legislation/bills/2025/S3797

[17] Ibid.

[18] The New York State Senate, Senate Bill S5726, 2013-2014 Legislative Session, Regulates the production of synthetic turf. https://www.nysenate.gov/legislation/bills/2013/2013-s5726.

[19] Sandra Goodrow, Ph.D., Research Scientist I, Division of Science and Research, "Technical Memorandum, PFAS in Artificial Turf," State of New Jersey, February 8, 2023. https://dep.nj.gov/wp-content/uploads/dsr/pfas-artificial-turf-memo-2023.pdf

[20] "July 29 – US: Artificial Turf Suit Settled By California AG," July 29, 2010, nexreg, https://www.nexreg.com/july-29-us-artificial-turf-suit-settled-by-california-ag?noamp=mobile; Jared Firestone, "Artificial Turf Cancer Lawsuit: Toxic Compounds May be Linked to Cancer" *Expert Institute*, May 2, 2025. https://www.expertinstitute.com/resources/insights/artificial-turf-cancer-lawsuit-toxic-compounds-may-be-linked-to-cancer/

[21]The Athletic Staff, "Which NFL stadiums have artificial turf and which have grass? Everything you need to know," *The New York Times*, October 18, 2023, https://www.nytimes.com/athletic/4974514/2023/10/18/nfl-stadiums-artificial-turf-grass-playing-surfaces/; Jourdan Rodrigue and Daniel Popper, "Field of nightmares: Inside the NFL, player divide over playing surfaces", *The New York Times*, Jan. 11, 2023. Updated Sept. 14, 2023 , https://www.nytimes.com/athletic/4074335/2023/01/11/nfl-turf-fields-injuries/

[22] Jesse Kirsch, "With World Cup looming, these scientists are trying to create the perfect grass," *NBC News* , June 11, 2025, https://www.nbcnews.com/sports/soccer/world-cup-looming-scientists-are-trying-create-perfect-grass-rcna210071; "UT Leads Research Project to Create the Perfect Pitches for FIFA World Cup 2026", *The University of Tennessee Knoxville News.* May 3, 2024, https://news.utk.edu/2024/05/03/ut-leads-research-project-to-create-the-perfect-pitches-for-fifa-world-cup-2026/

[23] Adrian Nita, "U.S. Stadiums Switch to Grass for FIFA World Cup 2026," *LawnStarter*, December 15, 2024, https://www.lawnstarter.com/blog/sports-turf/us-world-cup-cities-natural-grass/; Larry Lage, "FIFA aims for the perfect pitch at 2026 World Cup following fields called a disaster at Copa America," *AP*, August 30, 2024, https://apnews.com/article/2026-world-cup-pitch-grass-f1e923ad61497e4ec450a2a7d17c0ba9

[24]Tom Perkins, "Athletes likely to have higher levels of PFAS after play on artificial turf – study", *The Guardian*, March 15, 2024, https://www.theguardian.com/environment/2024/mar/15/athletes-higher-pfas-levels-artificial-turf#:~:text=All%20artificial%20turf%20is%20made%20with%20what,inhaled%2C%20ingested%20or%20get%20in%20open%20wounds

[25] Stephanie Wein, *Penn Environment, Research & Policy Center*, Water and Conservation Advocate, PennEnvironment Research & Policy Center, https://environmentamerica.org/pennsylvania/center/updates/dangerous-play-studies-find-harmful-forever-chemicals-in-artificial-turf-fields/#:~:text=This%20all%20while%20Philadelphians%20–%20and,acute%20mortality%20in%20coho%20salmon: see also Barbara Laker and David Gambacorta " *Field of Dread*, Six former Phillies died from the same brain cancer. We tested the Vet's turf and found dangerous chemicals," *Philadelphia Inquirer*, March 7, 2023, https://www.inquirer.com/news/inq2/astroturf-vet-artificial-turf-pfas-forever-chemicals-glioblastoma-cancer-phillies-1980-20230307.html

[26] David Gambacorta and Barbara Laker, "Amid a battle over turf plans for FDR Park, experts say claims of PFAS-free fake grass are misleading," *The Philadelphia Inquirer*, July 25, 2024; Barbara Laker and David Gambacorta, "'Forever Fields': How Pennsylvania became a dumping ground for discarded artificial turf, Danish company Re-Match secured state incentives to open a recycling plant in 2022. It hasn't happened yet. Meanwhile, thousands of rolls of the fake grass, containing PFAS, are piled up on farms," *The Philadelphia Inquirer*, December 13, 2023.

[27] Ximena Conde, "Lawsuit opposing FDR Park renovation will get another day in court," *The Philadelphia Inquirer*, August 15, 2025.
In a win for opponents of the plan, the Commonwealth Court of Pennsylvania said Orphans Court had jurisdiction on the matter.

[28] Hiroko Tabuchi and Ken Belson, "Is Fake Grass Safe? A Manufacturer Sues to Stop a Discussion," *The New York Times*, June 17, 2025, https://www.nytimes.com/2025/06/17/climate/artificial-turf-grass-lawsuit-defamation-health-risk.html?unlocked_article_code=1.QE8.q0H4.Ugks-Lqz54l0&smid=nytcore-ios-share&referringSource=articleShare; EHN Curators, "Lawsuit halts turf safety talk as scientists face legal threats over PFAS concerns," *Environmental Health News* June 18, 2025, https://www.ehn.org/lawsuit-halts-turf-safety-talk-as-scientists-face-legal-threats-over-pfas-concerns; PEER, Public Employees for Environmental Responsibility, " Artificial Turf Company Hit with Big SLAPP Suit," June 18, 2025, https://peer.org/artificial-turf-company-hit-with-big-slapp-suit/; Dechert, " PFAS Out, Libel In: Testing the Boundaries of Defamation and Tortious Interference" February 27, 2025, https://www.dechert.com/knowledge/re-torts/2025/2/pfas-out--libel-in--testing-the-boundaries-of-defamation-and-tor.html

[29] "The Trouble with Turf" January 23,2025. Wespac Foundation, https://wespac.org/event/the-trouble-with-turf/

[30] Dechert, "How Far Can a Blanket Statement Go? Environmental Group Files anti-SLAPP Suit Responding to Defamation Suit Over PFAS Statement," June 30, 2025, https://www.dechert.com/knowledge/re-torts/2025/6/how-far-can-a-blanket-statement-go--environmental-group-files-an.html ; Robert Freedman, "Manufacturer accused of trying to stop talk on possible turf health impacts," *Facilities Dive,* June 30, 2025, https://www.facilitiesdive.com/news/Polyloom-accused-stopping-Grassroots-webinar-turf-health-impacts/751984/

[31] Hiroko Tabuchi and Ken Belson, "Is Fake Grass Safe? A Manufacturer Sues to Stop a Discussion," *The New York Times*, June 17, 2025, https://www.nytimes.com/2025/06/17/climate/artificial-turf-grass-lawsuit-defamation-health-risk.html?unlocked_article_code=1.QE8.q0H4.Ugks-Lqz54l0&smid=nytcore-ios-share&referringSource=articleShare; Media Desk, "TenCate Grass North America sues environmental group," Sportsfields, March 5, 2025, https://sportsfields.info/tencate-grass-north-america-sues-environmental-group/

[32] Rihem Akkouche, "TenCate vs FieldTurf: Battle Over Trade Secrets Intensifies," *USA Herald*, July 3, 2024. https://usaherald.com/tencate-vs-fieldturf-battle-over-trade-secrets-intensifies

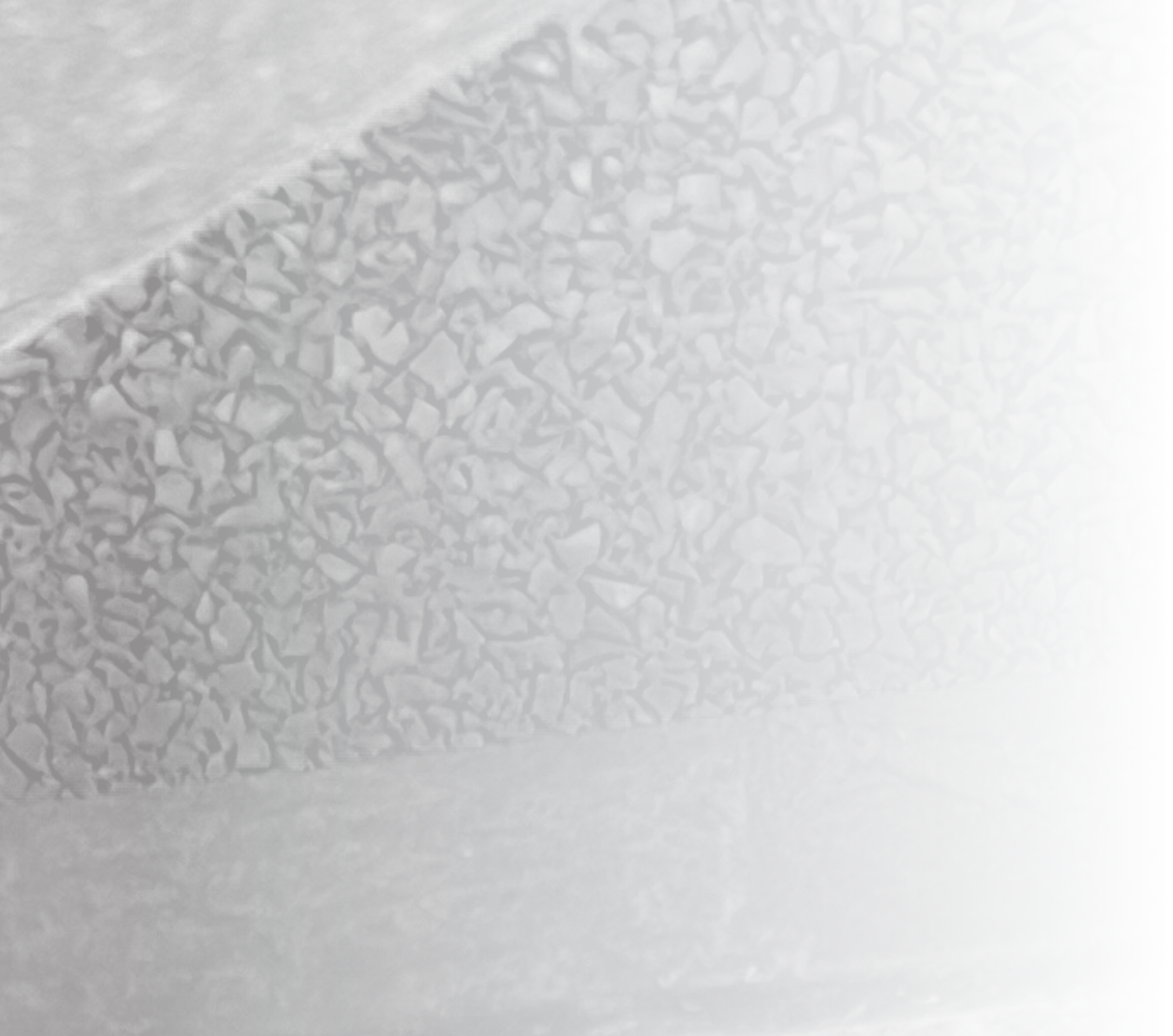
[33] Christopher Yasiejko, "TenCate Unit Sues Chinese Makers of Fake Grass for Lost Profits," *Bloomberg Law*, July 5th, 2023. https://news.bloomberglaw.com/ip-law/tencate-unit-sues-chinese-makers-of-fake-grass-for-lost-profits. See also Womble Bond Dickson, "Turf War: Lawsuit Sprouts Over Artificial Grass Patents," July 12, 2023, https://www.lexology.com/library/detail.aspx?g=9f245d18-6ec7-4def-a259-56d6f93960fa

[34] https://unicourt.com/case/pc-db5-polyloom-corporation-of-america-v-farrant-et-al-639385

[35] https://unicourt.com/case/rc-db1-casehc702920c4b871-345332?init_S=c_relc

[36] https://unicourt.com/case/pc-db5-casegu0e707e6124e8-1527294?init_S=c_relc

This page is intentionally left blank



5.4
SafetySurface

Safety Surface, Credit MNLA

SAFETY SURFACE DETAIL

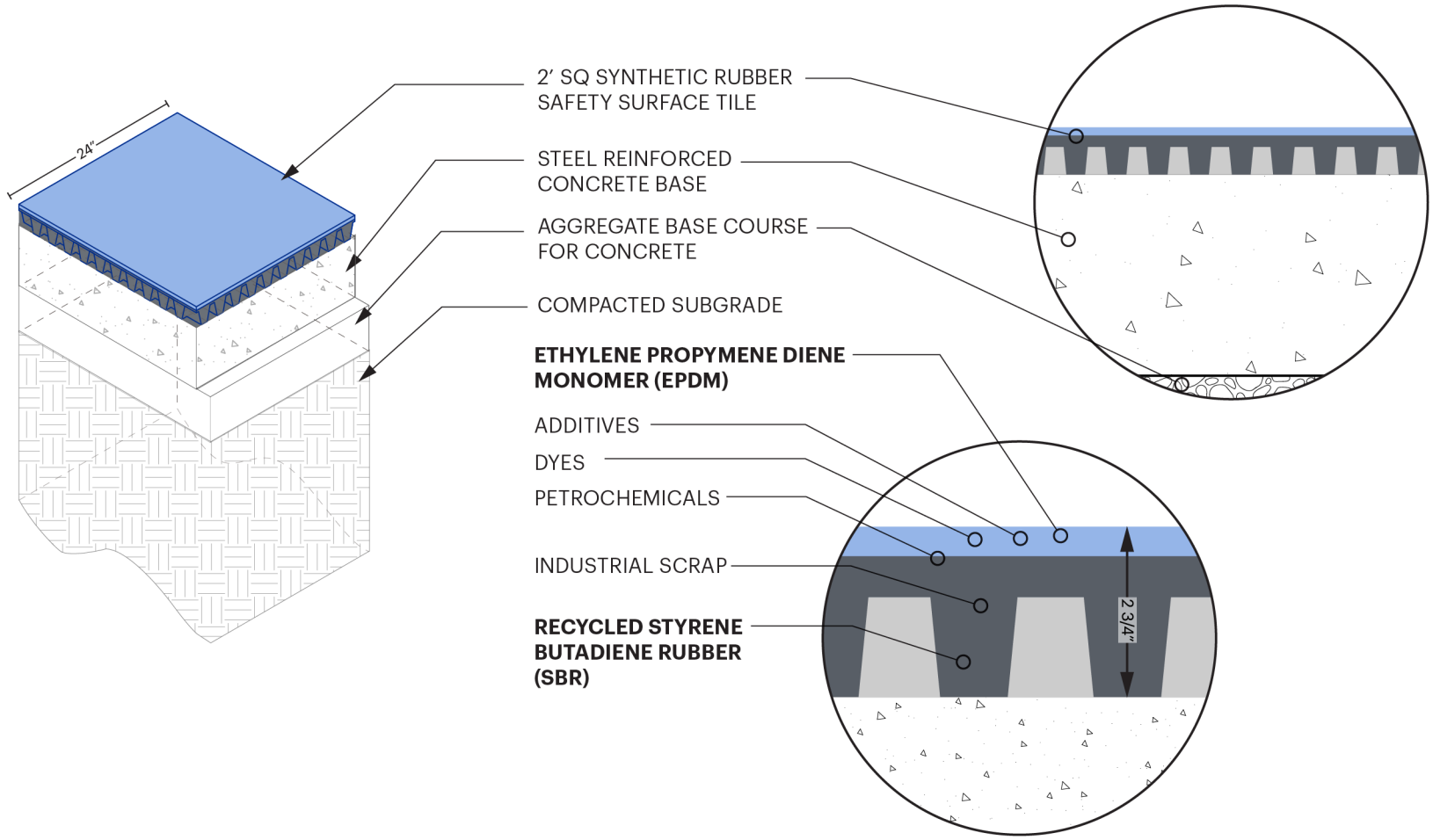


Figure 5.32, Safety Surface Detail, Credit MNLA

5.4 SAFETY SURFACE

What is Safety Surface and why is it used?

Safety surface is a shock-absorbing product that is used to cushion the potential fall of young children in playgrounds. A playground is a magical place where children can develop their senses through exploration and social play; one of the most exciting experiential features for children in playgrounds is the sense of varying heights. Most landscape architects employ varying heights and scales to enhance a child's experience of play. Safety, however, must come first regarding the choice of materials for cushioning the potential fall of children at play. Employing safeguards on the ground surface and around playground equipment is essential to ensure against life-threatening injuries.[1]

Equally important is creating a functional space and "groundscape" that is visually attractive and enjoyable for children. This can be achieved by using bright and colorful shock-absorbing surfaces that equally ensure varying heights and equipment do not pose undue dangers to children.

Safety surfacing is the dominant material used in playgrounds in New York City typically specified by agencies, clients, and landscape architects. For this reason, our team selected safety surfacing as one of the five materials to study. As cited in 2018 data issued by NYC Parks for capital projects, safety surfaces typically comprised relatively small footprints of landscaping contracts, yet their cost percentage of the entire yearly budget (4.6%) was the same as that of synthetic turf (4.5%) which has a surface area almost three times that of safety surfaces.[2]

Material Composition and Manufacturing

Safety surfaces are made of various materials including engineered wood fibers, vulcanized virgin rubber, recycled rubber (post-consumer or postindustrial), thermoplastic polymers, thermoset elastomers, or synthetic turf.[3]

Engineered wood fiber EWF: EWF are wood splinters in the form of a mulch, made of both softwood and hardwood lumber. This product is cost effective, with excellent shock absorption, even if it requires raking to keep it evenly distributed. Many EWF manufacturers claim IPEMA[4] (International Play Equipment Manufacturers Association) certification but ASTM F1951-21[5] (NYC Parks requires) does not include recognize the IPEMA certification.
Vulcanized natural rubber: vulcanized natural rubber is made from latex harvested from the rubber tree (*Hevea brasiliensis*, the Pará rubber tree, *sharinga* tree, or *seringueira* tree). Natural rubber has been made from the tree's latex since the end of the 19th century.

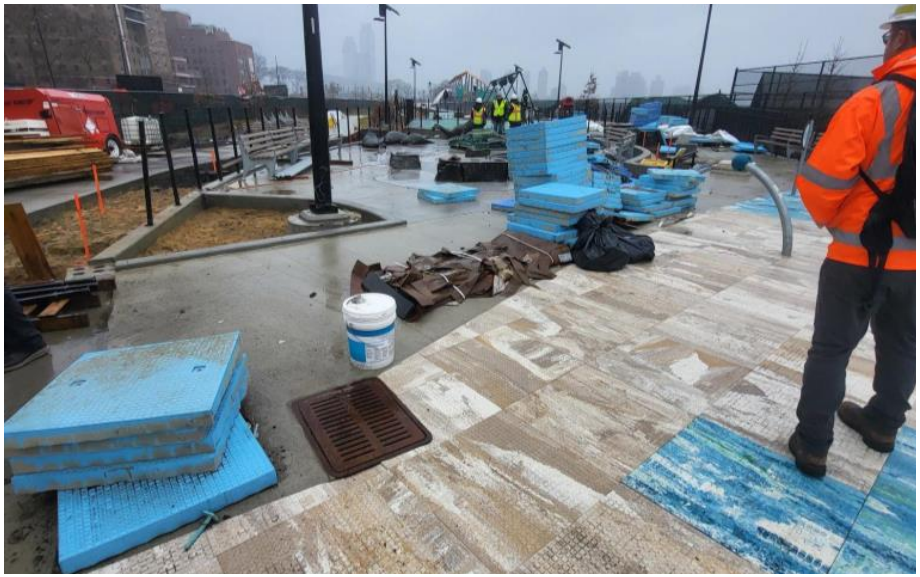
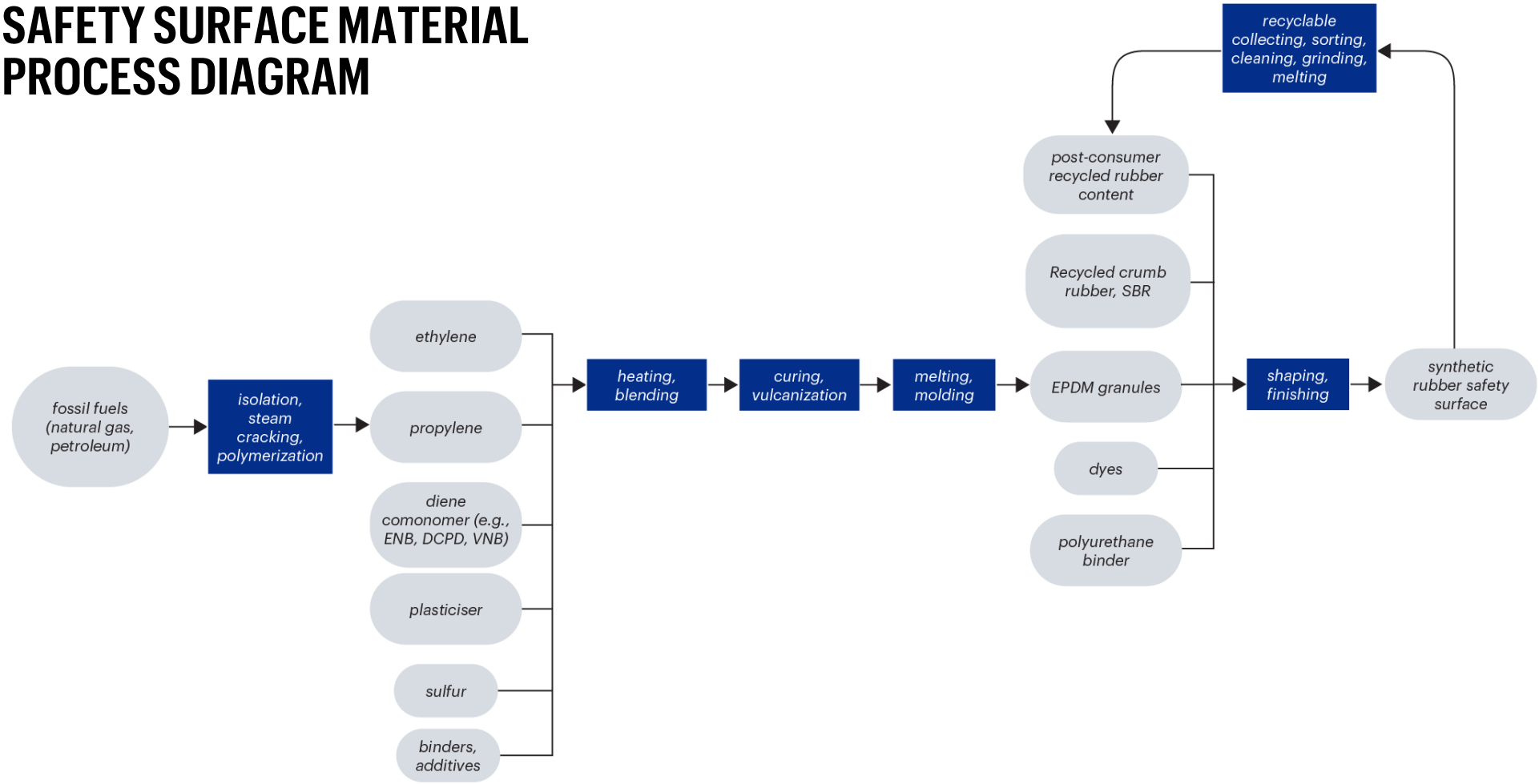


Figure 5.33, Safety Surface Installation, Credit MNLA

Our interviews with representatives of safety surface manufacturers suggest that natural rubber is no longer sourced for this product. Its use for playground safety surfaces has been largely superseded by recycled rubbers and polymer-based thermoplastic and thermoset elastomers. Only one playground manufacturer, SS3, confirms using natural rubber for parts of their playground equipment (not their safety surface product), where they self-report this material is sourced using responsible farming practices. They claim to source the rubber from approved FSC Rubber farms and they respect the Global Platform for Sustainable Natural Rubber (GPSNR).[6] However, even with known safe guards in place, GPSNR reported in 2021 the continued high risk of land use change and biodiversity loss in rubber forests in Vietnam.[7] SS3 is also identified as an accredited member of the "Made in Britain Green Growth Programme," and while it claims advantages to using natural rubber because it is biodegradable (compared to synthetic petrochemical plastics), this claim cannot be substantiated. Rubber latex used industrially is typically

SAFETY SURFACE MATERIAL PROCESS DIAGRAM



Sample mapping of safety surfacing manufacturing process

New graphic based on content from:
https://www.surfaceamerica.com/understanding-the-safety-of-surface-america-surfacing/
https://www.rubberecycle.com/posts/from-tire-to-rubber-mulch-the-process
https://rubber-surfaces.com/what-you-need-to-know-about-rubber-surfacing

Figure 5.34, Safety Surface Process Diagram, Credit MNLA

highly synthesized (chemically manipulated) in the manufacturing of the final product and hence no longer biodegradable.

Recycled rubber/EPDM Assembly: This widely used process is the material of choice for four of the seven manufacturers we investigated (SS3, SS4, SS5, & SS7). This product is manufactured in two forms, as unitary tiles and as a poured-in-place (PIP) contiguous surface. The recycled rubber is typically used in the bottom layer of a two-layer assembly.

SS4, for example, claims to use 100% post-consumer recycled "rubber" for the base layer of their two-layer product, even if this claim was not substantiated. Using recycled rubber is promoted as sustainable because it reduces waste and contributes to material circularity. And as with SS4, many PIP safety surface manufacturers tout 100% post-consumer recycled content made of recycled Styrene Butadiene Rubber (SBR) mostly from tires. However, because the recycled SBR used for the bottom layer of the safety surface cannot be melted down and reformed like a thermoplastic (since it is a thermoset polymer), it must be ground or shredded into small granules and reset withing a resin. This further contributes to the petrochemical content of the final product and its CO2 emissions and footprint.

The base level of recycled rubber is not in direct contact with children and because it is poorly resistant to ultraviolet degradation (UV), weather, and temperature extremes it benefits from being covered with a layer of Ethylene Propylene Diene Monomer (EPDM). EPDM is a synthetic petrochemically sourced rubber, which is further synthesized with a Thermoplastic Vulcanizate (TPV) material which provides shock absorption.

In what concerns the use of post-consumer tires for the base layer of safety surface, it would be useful to understand which recycling processes and companies are certified and under what regulations they operate. In addition, there is some concern that such products are environmentally dangerous for use in playgrounds.[8]

Thermoplastic and thermoset polymers: EPDM is a thermoset polymer, and TPV is a Thermoplastic Vulcanizate. TPV is recyclable, but EPDM is not. EPDM must be ground down to a crumb and set within a new resin if it is to be reused after its first use. TPV is higher in cost, and it can, in theory, by repeatedly melted and reprocessed even if there little to no evidence that this is happening in the industry. SS6 uses this assembly type for both its upper and lower layer.
Synthetic turf: Synthetic turf is another popular option for designers' especially in NYC Parks playgrounds where designers cannot otherwise create sloped landforms as part of the play elements of the playground (since NYC only allows the use of unitized systems). If using synthetic turf for the making of safety surfaces this requires the introduction of shock pads over an asphalt base. In addition, synthetic turf safety surfacing may require a proper underlayment of padding.

As described in greater depth in the narrative dedicated to synthetic turf, there are negative impacts associated with its use including health and environmental concerns. These include heat retention and microplastic pollution caused by the breaking down and shedding of microplastic over time, the increase of non-recyclable materials and landfill waste, and concomitant bacterial growth without frequent sanitation operations.

Safety Surface used in New York City

At this time, the main raw material component of safety surfaces used in NYC is a thermoset elastomer polymer from which Ethylene Propylene Diene Monomer (EPDM) is made. This polymer begins its life in petroleum and natural gas. NYC Parks notes in their specifications that "safety surfacing consisting of [recycled] rubber crumbs bonded together with a polyurethane binder and/or poured-in-place (PIP) surfacing are not acceptable."[9] Accordingly, NYC Parks allows only tile rubber materials (unitary rubber) and not PIP safety surfaces, because tiles are easier to replace. Regardless of NYC Parks preferences, designers generally prefer PIP surfacing because it facilitates a freeform layout and color variations not limited to rectangular shapes.

As per NYC Parks' 2022 specification, the formulation of safety surfaces was described as "a waffle type compression molded "rubber" mat," and in 2024, it added "or injection molded thermoplastic mats." To be clear, common rubber materials for compression-molded rubber, acceptable to NYC Parks, include natural latex sourced rubber and synthetic (petroleum-based) virgin SBR (Styrene Butadiene Rubber) and EPDM (Ethylene Propylene Diene Monomer). The research team contacted representatives of the company that has supplied safety surface to NYC Parks since 1991, who confirmed that the type of safety surface used in NYC has always been synthetic rubber. It is notable, however, that information about the exact material origins of various safety surfaces is not always readily available on company websites.

Manufacturer Engagement and Data Access Challenges

Our team investigated seven safety surface companies. The acronym we used for this material is SS1, SS2, SS3, etc. Five of the seven companies (SS1, SS2, SS3, SS6, SS7) offer unitary tile systems; one manufacturer offers a hybrid of recycled crumb rubber bonded together to constitute a unitary tile system. Two of the eight companies did not yield any substantial data of use to the investigation.

Corporate Social Responsibility Profile

Regulating and certifying ethically sourced materials for safety surfaces is necessary, if challenging, because the very purpose of employing safety

Figure 5.35, Safety Surface, Credit MNLA

surfaces in playgrounds is to ensure children's safety and reduce injuries from falling. This is the main performance variable for which these materials are tested.

The most widely used test method for evaluating the shock-absorbing properties of playgrounds is described in ASTM F1292-22. The International Play Equipment Manufacturers Association (IPEMA) provides a product certification program which validates a participant's product to conform to certain ASTM standards. (See certification section: https://ipema.org/certification-program/).[10] This is an important regulation, even if only attendant to the material performance of the product. In what concerns possible environmental and health related issues associated with this material, none of the seven companies we investigated have EPDS or HPDs. Moreover, none of the companies have comprehensive Corporate Social Responsibility (CSR) profiles.

The parent company of SS1, however, does have a published Human Rights Statement in their annual report from 2024. This is a substantially sized company in the polymer industry and as such it is expected that they would have this scale of CSR accountability. SS3 gained an Environmental & Social Value (ESV) certification on August 5, 2025. And SS4 has an ESG Environment and Social Governance statement through their parent company. The parent company is also a substantially sized company expected to have clearer reporting on ESG policies.

To achieve their sustainability goals, one company states their business employs the practice of "circularity" which prioritizes the reuse, recycling, and regeneration of materials and resources. Most of these claims, however, cannot be substantiated. SS6, for example does not have any EPDS or HPDS, yet they claim that their thermoplastic raw materials are manufactured in Norcross, Georgia and Fort Worth, Texas, their tiles are molded in Savanna, Il and they are 100% US manufactured. However, there is no documentary evidence to prove that their upstream petroleum materials are not sourced outside the US.

Many existing certifications associated with the forced labor are related to the harvesting of "natural" rubber in Southeast Asia. Sources useful to the industry include the Global Platform for Sustainable Natural Rubber (GPSNR), https://sustainablenaturalrubber.org, located in Singapore. SPOTT is another certification, this time "*a free, online platform assessing commodity producers, processors and traders on their public disclosure regarding their organization, policies, and practices related to environmental, social and governance (ESG) issues,*" for palm oil, timber, and pulp, and natural rubber.[11] Lastly, Fair Rubber. org is a group that certifies companies who produce rubber for home textiles, gardening accoutrements, bathroom and home accessories, footwear, and bicycle tires. They do not, however, certify building construction products.[12]

FORCED LABOR RISKS FOR SAFETY SURFACE

The Material in the News?

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component as SS1 to SS7)

The material product which purports to offer "safety" for some, is, and has been, dangerous for others. This is the case for upstream materials used in the making of safety surface be they made of natural rubber, synthetic recycled rubber, or petrochemical derived polymers.

When any part of a safety surface or playground furniture begins its life in natural rubber, it participates in a manufacturing process with a dark history of forced labor. Rubber plantations have exploited laborers and children for more than a hundred years. They continue to do so even today in the extraction of the latex that is the main material in "natural" rubber.

Historically, rubber extraction in the late 19th century began in Brazil with the harvesting of wild, non-farmed latex. Once the latex source was identified, Western British forces led by Henry Wickham "*pulled off one of the most successful and far-reaching acts of biological piracy*" as noted by Joe Jackson in his book *The Thief at the End of the World, Rubber, Power and the Seeds of Empire*.[13] Wickham had gathered and transported to London's Kew Gardens seeds of the Amazonian rubber plant, where they were cultivated for transplantation to the British colonies of Ceylon (Sri Lanka), Malaya, and Singapore at the beginning of the 20th century.[14] Subsequent rubber plantations in southeast Asia and Africa which set out to produce industrial quantities of latex and are clear legacy of western colonialism at the expense of local populations.[15] By the 1920s, Americans who were the biggest consumers of rubber at the time, undertook two significant corporate settler colonial expeditions. The first was by car manufacturer Henry Ford, who in Brazil established the colony of Fordlandia where he set out to farm the *Hevea brasiliensis*.[16] The second was by Harvey Firestone who developed a rubber plantation in the free state of Liberia, Western Africa.[17] Firestone was much more successful in growing and harvesting trees that Ford, given the good fortune of not finding the parasite which otherwise endangered the tree in Fordlandia.

During this period of colonial oversight in rubber production, forced labor was common and endemic in the supply of rubber used in the automotive industry, as it was in the making of textiles and household goods including rubber bands, boots, and raincoats. Until the Second World War, indigenous populations who toiled in Southeast Asia, Africa, and the Amazon experienced untold human traumas for producing this "natural" commodity.

While rubber products were available by 1890, in 1909, a team headed by Fritz Hofmann, working at Bayer Laboratory in Germany succeeded in polymerizing isoprene (synthesizing it into an elastomer from petroleum by products), delivering to market the first synthetic rubber. In 1930, Dupont developed the first commercially successful synthetic rubber, known as neoprene.[18] Production of synthetic rubber in the US expanded greatly during World War II. With Japan having conquered most of Asia, particularly in the Southeast Asian colonies of British Malaya (now Malasia) and the Dutch East Indies (now Indonesia) from where much of the global supply of natural rubber was sourced, new sources for natural rubber were needed.

Today, forced labor in the production of (natural) rubber in Southeast Asia and Western Africa continues to be a serious issue. Far from being a thing of the past, contemporary production of rubber in Liberia is still rife with forced labor, with companies reluctant to acknowledge the harsh conditions under which those who harvest latex from trees are subject to abuse.[19] Small-scale individual laborers have little collective bargaining power in the face of managers who collect the latex from them at ridiculously low prices.[20] Intervening handlers exploit the supply chain before large companies purchase the harvested latex. Just this year, a news story revealed how particularly harmful rubber production in West Africa is to women. As reported by Bloomberg, women are sexually abused at a company run by the Socfin Group (Société Financière des Caoutchoucs), headquartered in Luxembourg.[21] Moreover, a lawsuit was filed by the International Labor Rights Fund (ILRF) in November 2005, against Bridgestone whose Firestone plantation in Harbel, Liberia was accused of forced and child labor.[22]

The harvesting of palm oil—a so-called "bio-product" if used to replace latex or petroleum-based binders in safety surface manufacturing—contributes to similar conditions. More than a decade ago, *the Economist* identified problems in the contemporary supply chain of this material, this time in Cambodia.[23]
It is significant that rubber is a material that appears on the US Department of Labor "List of Goods Produced by Child Labor or Forced Labor" which

identifies countries at most risk of producing material commodities using forced labor.[24] The countries most at risk are Burma, Cambodia, Indonesia, Liberia, Philippines, and Vietnam. Rubber is also the subject of investigative work by VERITÉ, an organization which reports in material supply chains. They claim these countries are at risk for forced labor, child labor, or both: Burma, Cambodia, Côte d'Ivoire, Indonesia, Liberia, Philippines, Vietnam.[25] In 2022, the International Labor Organization issued the Guide, "Addressing, preventing and eliminating forced labour in the rubber industry in Malaysia: A practical guide for Malaysian employers."[26] Lastly, the Winrock report funded by USAID, "Tapped out, a research study on forced labor and trafficking in persons in the Thai rubber industry", speaks to the problem in Thailand.[27]

How do we know if any of these so-called natural/ bio-based products make their way into the supply chain of safety surface? What we do know is that natural rubber is found in roofing and flooring products; natural latex is used as an additive in concrete,[28] in seals and gaskets, for water proofing, and in paving with latex modified bitumen.

Forced labor issues in the supply chain of safety surface are also present in the production of synthetic rubber and petrochemical polymers that originate in Western China. Their synthetic nature does not shield them for labor issues. In fact, concerns with unsafe labor in the manufacturing of rubber flooring are also present in the United States. According to a July 2024 report by the US Department of Labor, Occupational Safety and Health Administration (OSHA), the Ecore International plant in Mexia Texas (near Austin) was cited for sixteen violations, some of them "serious safety violations", and fined closed to three hundred thousand dollars. At their plant in Ozark, Alabama, OSHA "*found similar machine guard hazards unchecked and employees exposed to potential electrocution and amputation dangers*" in May 2024.[29] Another company in this space, United Creations Ltd was also cited by OSHA in 2011 for "workplace safety or health violation" resulting in an 18,000$ fine.[30]

What does Sayari reveal about their supply chains?

With scant responses to the Manufacturer's Questionnaire, we turned to Sayari to reveal the material supply chains of most of our companies selling and installing safety surface.

- SS2, SS3, SS6 and SS7 are safety surface companies with extremely limited records in Sayari and as such we could not evaluate the risk of forced labor in their supply chains.

- SS5, is a safety surface company with a modest data set in Sayari. Amongst its suppliers, however, forced labor risk is noted in a second-tier supplier which has an Elevated Forced Labor risk of [1]. This would otherwise garner this company an orange risk level, however, given the small amount of data associated with this risk, we have evaluated it with a yellow risk level.

- SS1, is a safety surface company with many associated subsidiaries and affiliated companies in Sayari. Because they are associated with various rubber and plastics companies used across many different industries, a careful parsing of the material shipped and received was necessary. After a careful analysis, it was assessed that SS1 has a significant risk of force labor at its second-tier rubber supplier. This supplier has an Elevated Forced Labor risk of [5] because four of its own suppliers have Elevated and High labor risks. Of particular interest is the fact that these four, third -tier suppliers are all shipping low-grade commercial rubber waste from developing countries (South Africa, Algeria, Turkey, and Indonesia) to Europe for subsequent processing of this material in Thailand. This confirms that the global supply chain of polymer is highly complex and interwoven.

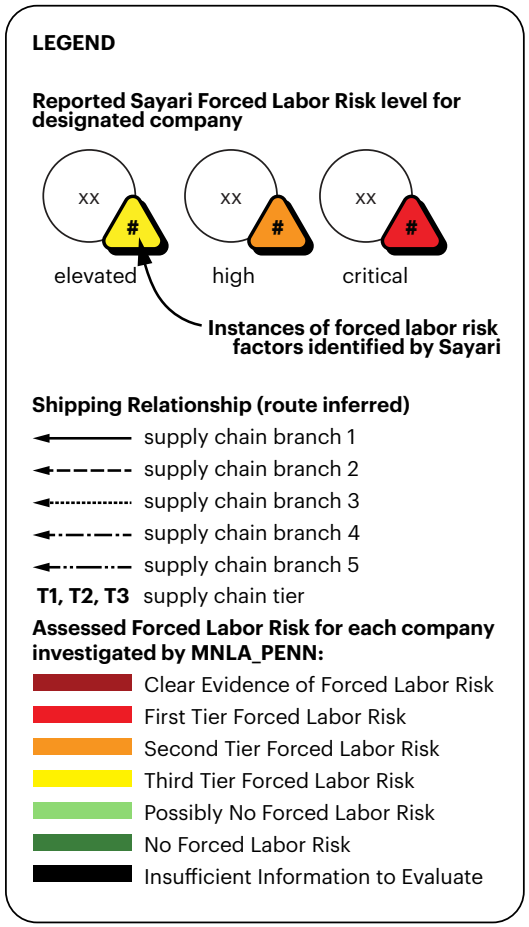
- SS4, is the safety surface company with the highest level of risk of forced labor in this product category. They have risk in their first-tier suppliers across three separate supply chains. Because this is a large flooring company, we ensured that only materials most related to safety surface were mapped back to the company. In this way, two additional supply chains, which had risk at their first tier were excluded from this evaluation, notwithstanding they may in fact be contributing content to the making of landscape safety surfaces. Of the supply chains directly related to this material, three had significant third, fourth, and fifth tier forced labor risk across their chains: two of which had direct connections to the manufacturing of petrochemicals in the Xinjiang region of China. The risks are so acute that upstream some of the companies had Critical Forced Labor risks of [4] and [8], while others had High Forced Labor risks of [9] and [7]. This company is also one of the companies whose profile has significantly changed over the course of our research. In 2024, at the very beginning of our research, this company had direct and immediate risk for forced labor in its supply chain. As of July 17, of this year, SS4 had a direct Elevated Forced Labor Risk of [8] which is significant. This would have garnered the highest level of dark red in our evaluations. Following Sayari data updates, by July 23, all [8] direct risks were removed. The risks to its first-tier companies, however, have remained.

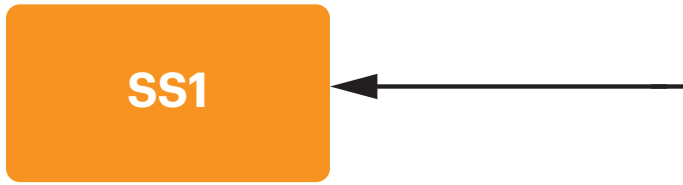
Figure 5.36, Safety Surface, Credit MNLA

Diagram of Global Supply Chain Risk

SS1

This image is a partial mapping of SS1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





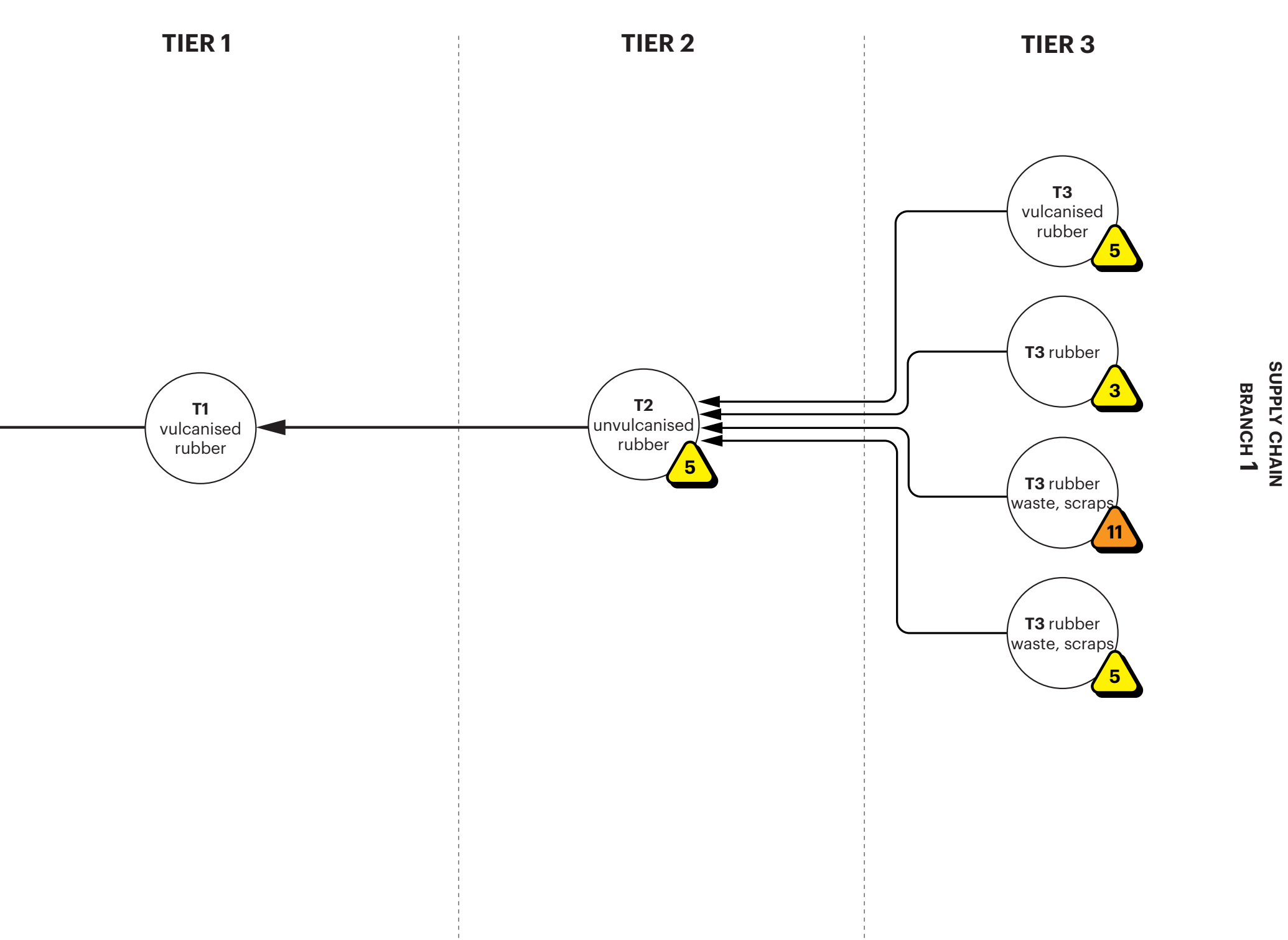
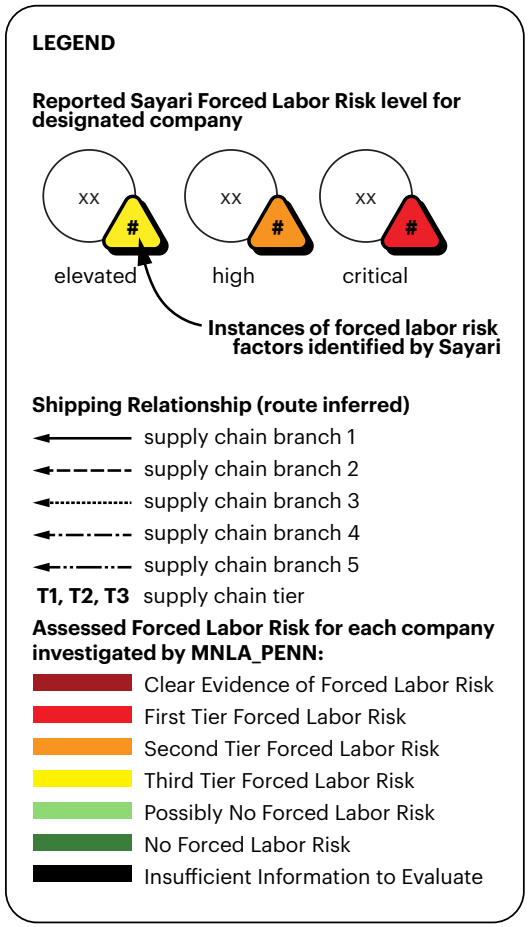


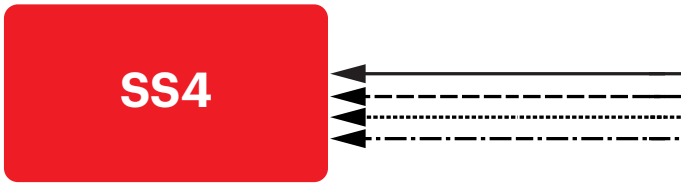
Figure 5.37, Diagram of Global Supply Chain Risk: SS1, Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

SS4

This image is a partial mapping of SS4's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





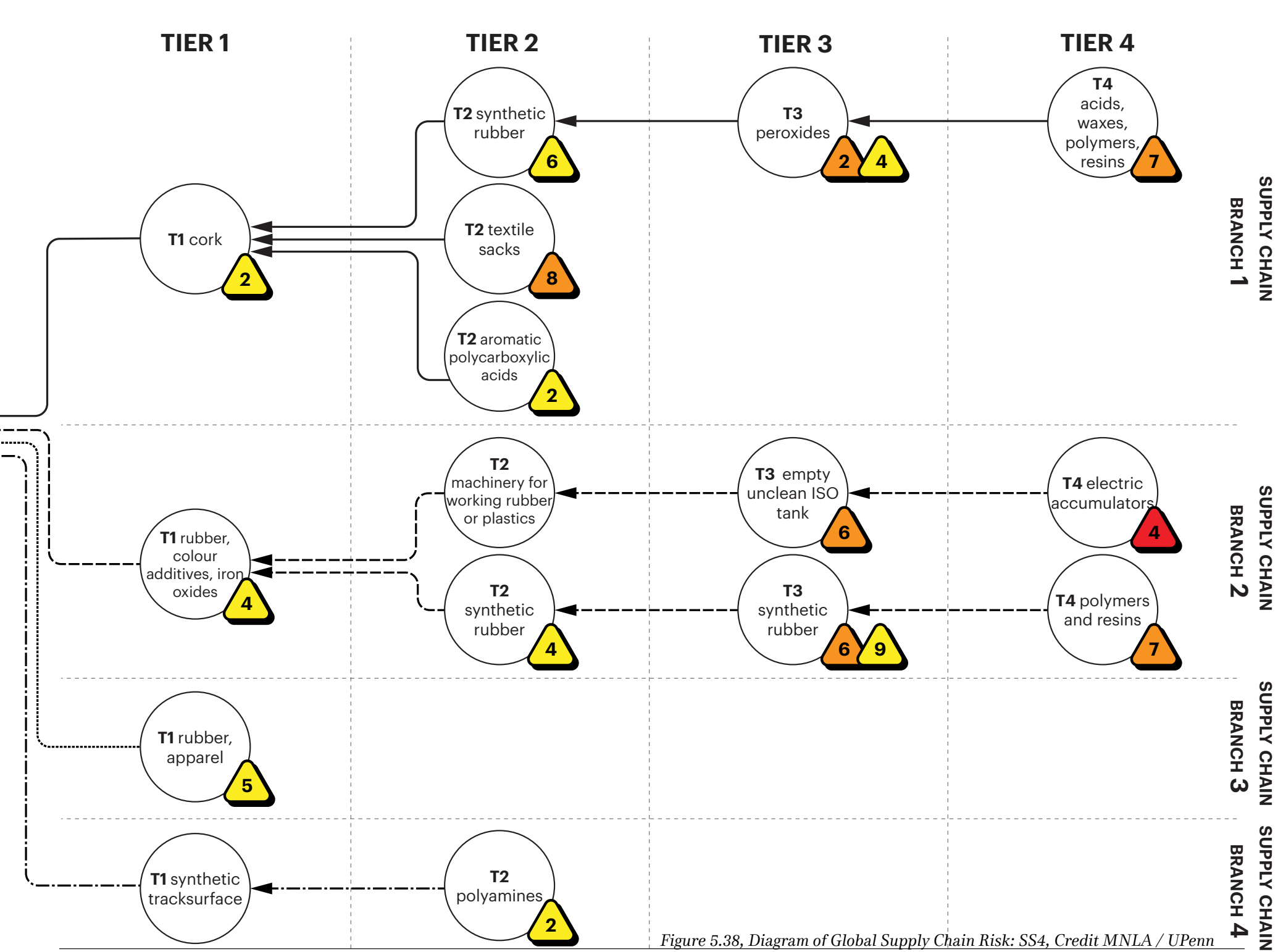


Figure 5.38, Diagram of Global Supply Chain Risk: SS4, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

SS4

This image is a partial mapping of SS4's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

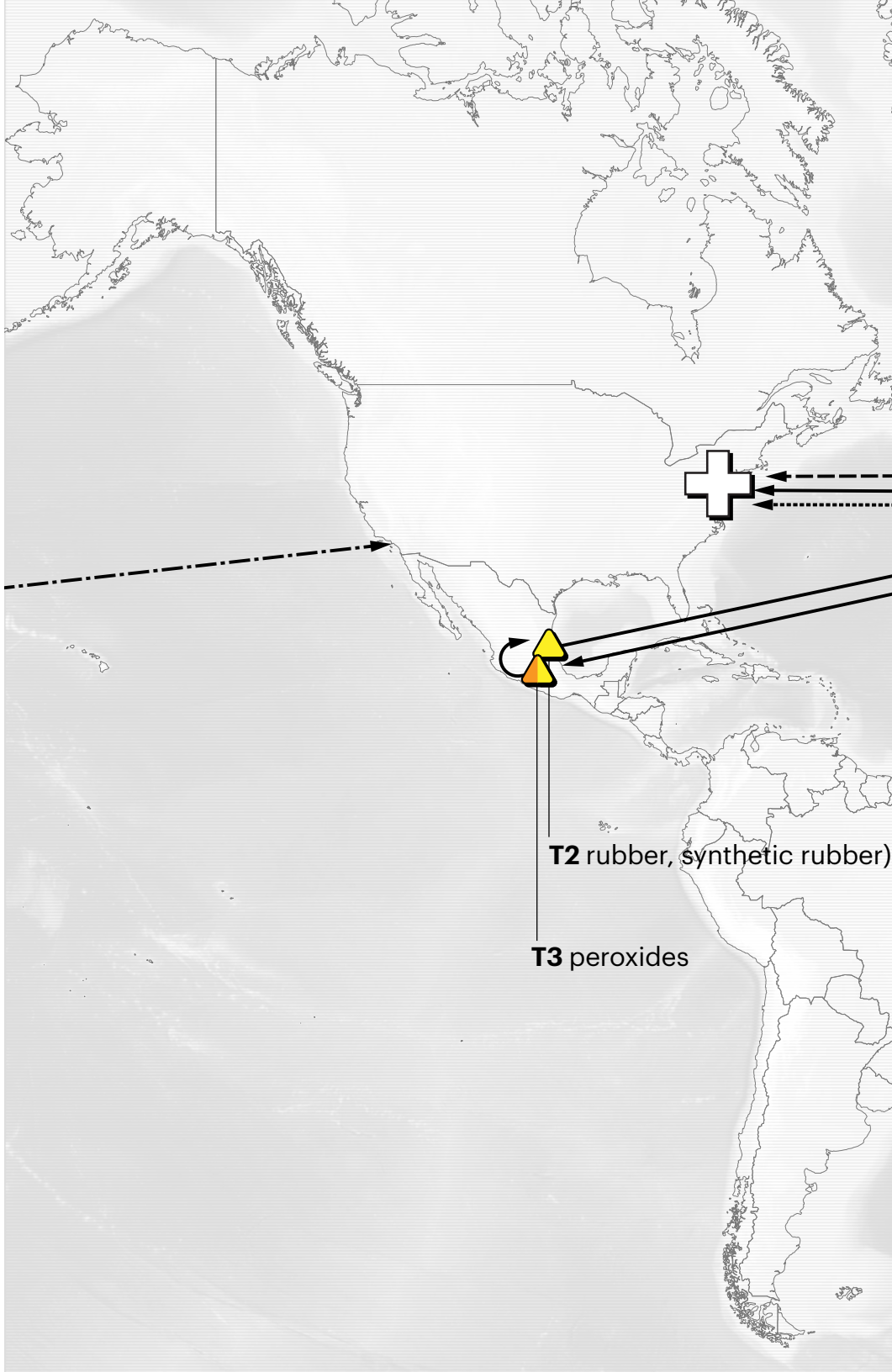
- no reported forced labor risk
- manufacturer headquarters

Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5
- **T1, T2, T3** supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate



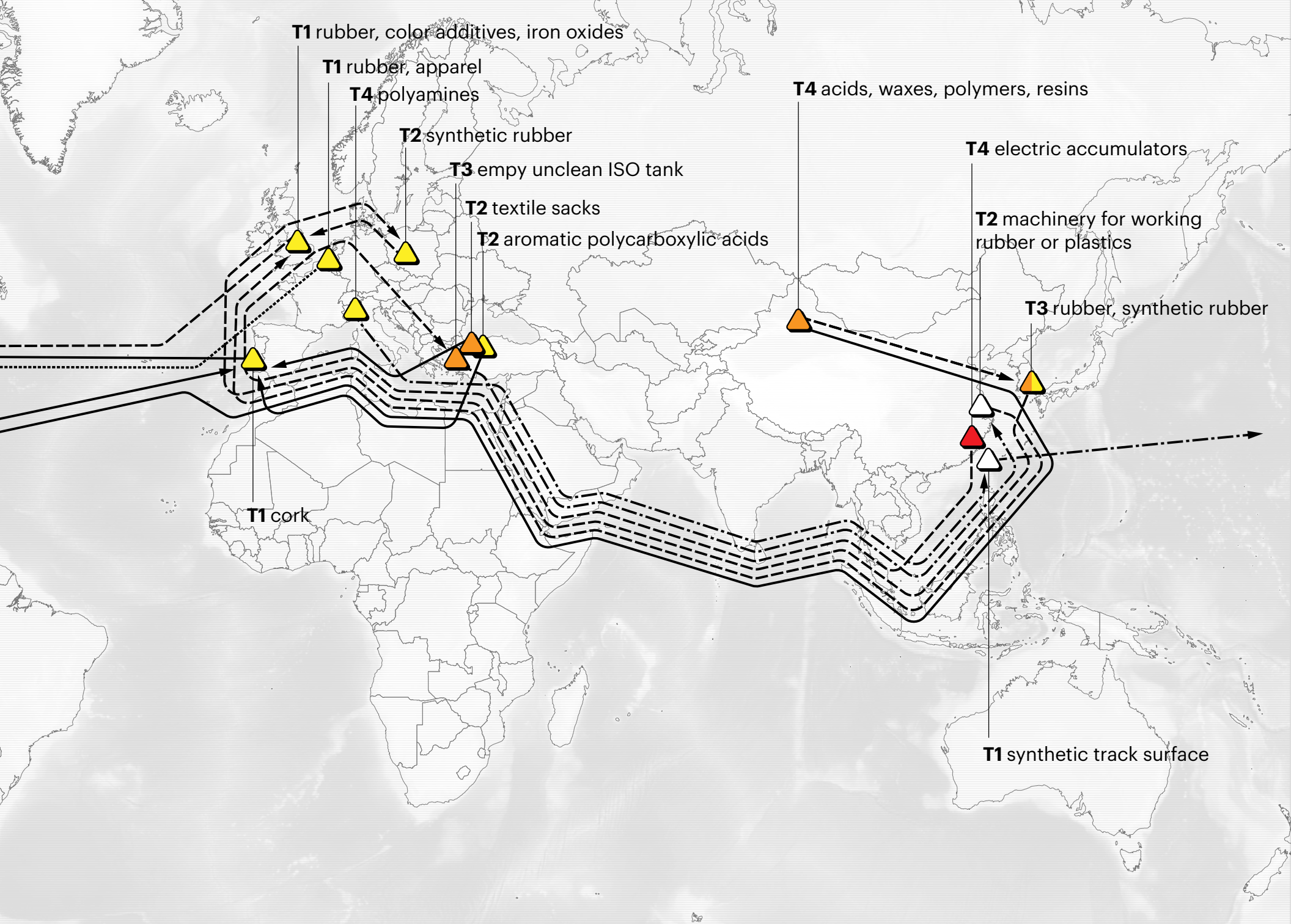


Figure 5.39, Shipping Map of Global Supply Chain Risk: SS4 Credit MNLA / UPenn

Endnotes

[1] Public Playground Safety Handbook, U.S. Consumer Product Safety Commission, 2015

[2] NYC Parks FOIL Request by MNLA May 2024.

[3] Charles W. Harris, *Time-Saver Standards for Landscape Architecture 2E*, (McGraw Hill, 2023): 910-5. See also Public Playground Safety Handbook, U.S. Consumer Product Safety Commission, 2015.

[4] IPEMA: International Play Equipment Manufacturers Association, https://ipema.org/. (IPEMA), is a non-profit, membership, trade association, also provides a product certification program for public play equipment and surfacing materials. (https://ipema.org/about-ipema/) See certification section: https://ipema.org/certification-program/.)

[5] F1951-2 is Standard Specification for Determination of Accessibility of Safe Systems under and around Playground Equipment. Most of the IPEMA certification are related to the impact attenuation.

[6] GPSNR Global Platform for Sustainable Natural Rubber, https://sustainablenaturalrubber.org

[7] GPSNR Global Platform for Sustainable Natural Rubber, "GPSNR Working Groups Update: June 2021", https://sustainablenaturalrubber.org; See also "Spatial data & mapping tools for detecting deforestation and threats to HCV/S areas in rubber production landscapes," October 23, 2020, www.zsl.org. Report developed by ZSL for the Global Platform for Sustainable Natural Rubber

[8] See Playground Professionals, "Why Are Dirty Tires Still on The Playground in 2024?" in *Play and Playground Magazine*, https://playgroundprofessionals.com/surfacing/rubber/tire-playground-surfacing

[9] "Safety Surfacing" Specification by NYC Department of Parks and Recreation, 2022 & 2024.

[10] IPEMA: International Play Equipment Manufacturers Association, https://ipema.org/.

[11] https://www.spott.org/about/

[12] https://fairrubber.org/about/

[13] Joe Jackson, *The Thief at the End of the World, Rubber, Power and the Seeds of Empire,*" (Penguin Books, 2009).

[14] Ibid., p. 108-112.

[15] Sheridan Prasso, Benoit Berthelot and Gaspard Sebag, " The Rubber Barons," *Bloomberg,* April 16, 2005, https://www.bloomberg.com/features/2025-socfin-plantations/

[16] Greg Grandin, *Fordlandia, The Rise and Fall of Henry Ford's Forgotten Jungle City* (Picador, 2009).

[17] Ibid., 21-31.

[18] Stephen Fenichell, Plastic, *The Making of a Synthetic Century* (Harper Business, 1997):162-165

[19] Sheridan Prasso, Benoit Berthelot and Gaspard Sebag, " The Rubber Barons," *Bloomberg,* April 16, 2005, https://www.bloomberg.com/features/2025-socfin-plantations/

[20] Julia Seibert, "Policy and Practice of Forced Labor in the Congo Free State and the Belgian Congo," *African History*, August 21, 2024; Serena Lin, "The world's largest rubber plantation is about to go on strike," Mother Jones, January 30, 2025.

[21] Sheridan Prasso, Benoit Berthelot and Gaspard Sebag, " The Rubber Barons," Bloomberg, April 16, 2005, https://www.bloomberg.com/features/2025-socfin-plantations/. See the response by Socfin to the Bloomberg story, Letter to the Editor, "Socfin Responds to Bloomberg Story on Rubber Plantations," April 16, 2025.

[22] World Forest Movement, "Liberia: Lawsuit against Firestone for slavery, child labor on rubber plantations," 8 January 2006 .

[23] "Rubber barons; Logging in South-East Asia." *The Economist*, vol. 407, no. 8836, 18 May 2013, p. 46(US). Gale In Context: Opposing Viewpoints, link.gale.com/apps/doc/A329985036/OVIC?u=upenn_main&sid=summon&xid=042be5ba. Accessed 26 Aug. 2025.

[24] US Government, "List of Goods Produced by Child Labor or Forced Labor," https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-goods-print?items_per_page=10&combine=rubber

[25] Verité, https://verite.org/project/rubber-3/

[26] https://www.ilo.org/publications/addressing-preventing-and-eliminating-forced-labour-rubber-industry

[27] https://winrock.org/wp-content/uploads/2022/09/Thailand-CTIP-Tapped-Out-Rubber-Industry-002.pdf

[28] Hassaan Bin Tariq, Roszilah Hamid and A. B. M. A. Kaish, "Mechanical Properties of Natural Rubber Latex-Modified Concrete: A Review," *IOP Conference Series: Earth and Environmental Science*, 2025. DOI 10.1088/1755-1315/1444/1/012007

[29] US Department of Labor, "Department of Labor finds one of the largest makers of reclaimed rubber flooring exposed Austin-area employees to willful, serious safety violations," July 15, 2024. https://www.osha.gov/news/newsreleases/region6/07152024

[30] See Violation Tracker Individual Record, https://violationtracker.goodjobsfirst.org/violation-tracker/ny-unity-creations-ltd

5.5
Recycled Plastic Lumber

Recycled Plastic Lumber Slats on Benches, Credit MNLA

RECYCLED PLASTIC LUMBER DETAIL

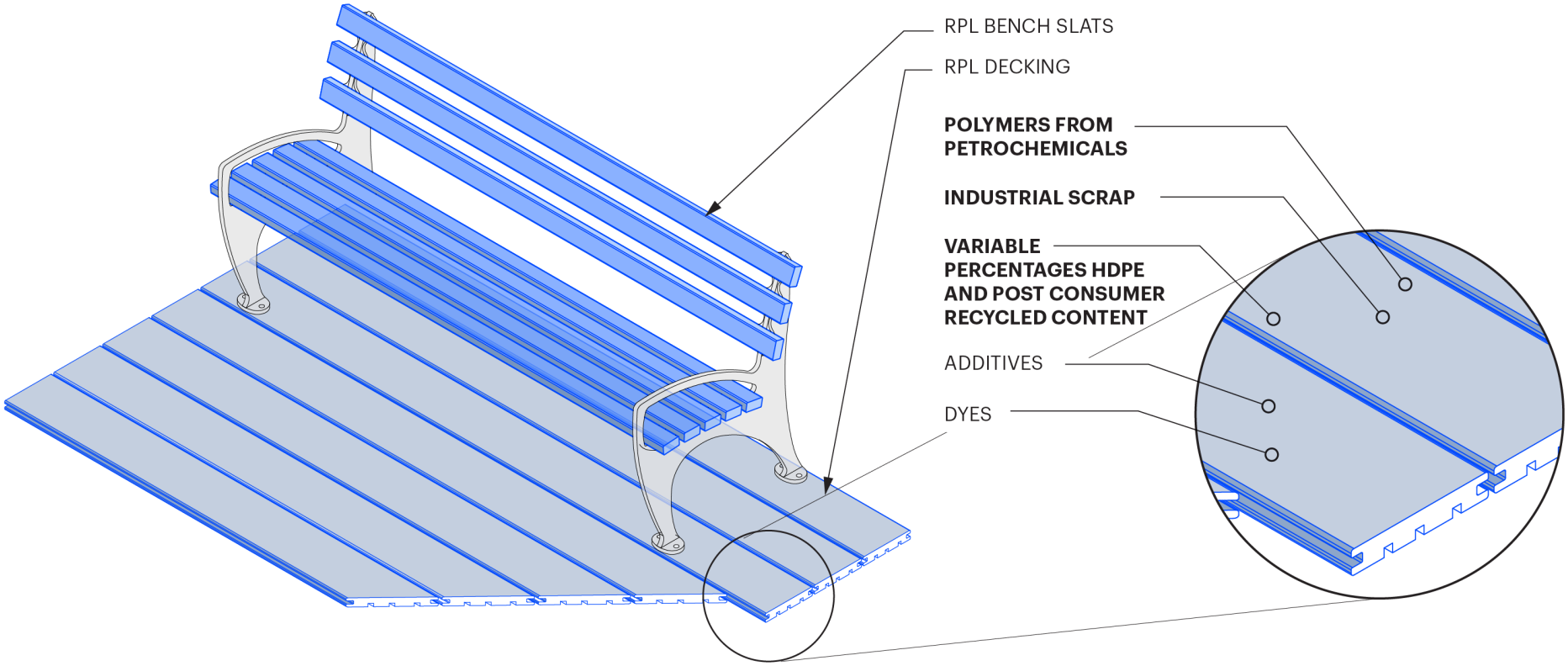


Figure 5.40, Recycled Plastic Lumber Detail, Credit MNLA

5.5 RECYCLED PLASTIC LUMBER

What is Recycled Lumber (RPL) and why is it used?

Recycled Plastic Lumber (RPL) is an alternative to wood, popular for applications that require extended durability and less maintenance. The team chose to investigate RPL because of its frequent use, ambitious sustainability claims, and potential risk. Landscape architects specify RPL as a replacement for natural wood in a variety of settings. Waterfront projects may feature docks and boardwalks made from RPL to resist water damage better than natural wood. Decks and patios often use RPL as a lower maintenance alternative. Outdoor furniture can incorporate RPL to mimic the aesthetic and slatting of natural wood while lasting longer. In New York City, NYC Parks' standard specifications include RPL slats for its typical benches, and its custom specifications have called for RPL in boardwalks.

The total bid price for RPL across NYC Parks contracts in the fiscal years 2018, 2019, and 2022 (the years for which we received FOIL records) was approximately $2,880,000.

Material Composition and Manufacturing

RPL is made from plastic chemistry, wherein raw plastics from petrochemicals are mixed with some percentage of recycled content, and various additives. Many formulas use high density polyethylene (HDPE) and a small percentage of additives such as dyes, UV protectants, and foaming agents. This is the approximate formula for five of the companies we investigated. While the level of recycled content varies across products, sources of recycled HDPE include milk jugs, detergent bottles, industrial containers, and factory trimmings. Other formulas for the making of RPL use low density polyethylene (LDPE), or a mix of HDPE and LDPE, and wood fibers or sawdust (often recycled or reclaimed), as well as chemical additives. Sources of recycled LDPE include plastic bags and films. Also known as "composite decking," this LDPE plus wood fiber formula describes only one of the companies we investigated (PL7). Other plastic lumber varieties use polypropylene, polystyrene, or polyvinyl chloride (PVC), though we did not include any such companies in this investigation.

At its origins, plastic is derived from fossil fuels, extracted and processed worldwide, from the US Gulf Coast to Xinjiang, China. Creating polyethylene often starts with natural gas. Facilities refine the gas, "crack" it by introducing steam to separate out ethylene, then polymerize it by adding mineral catalysts

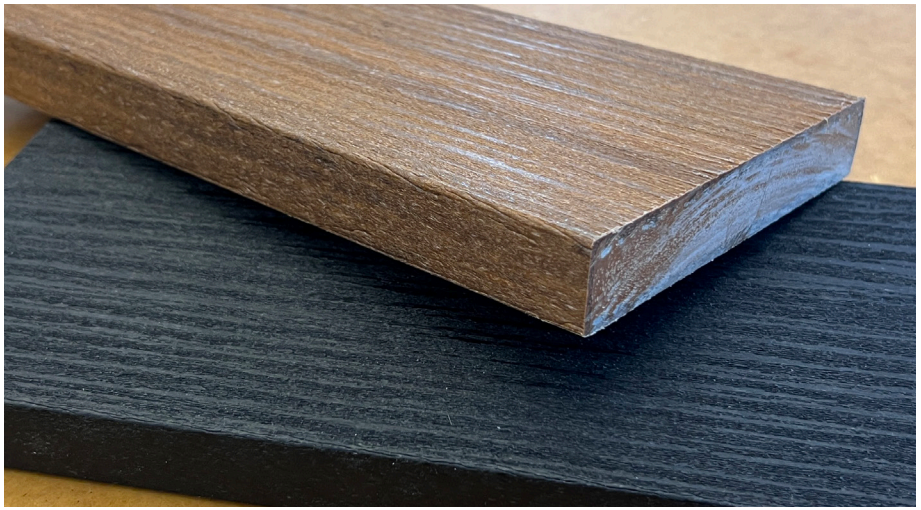


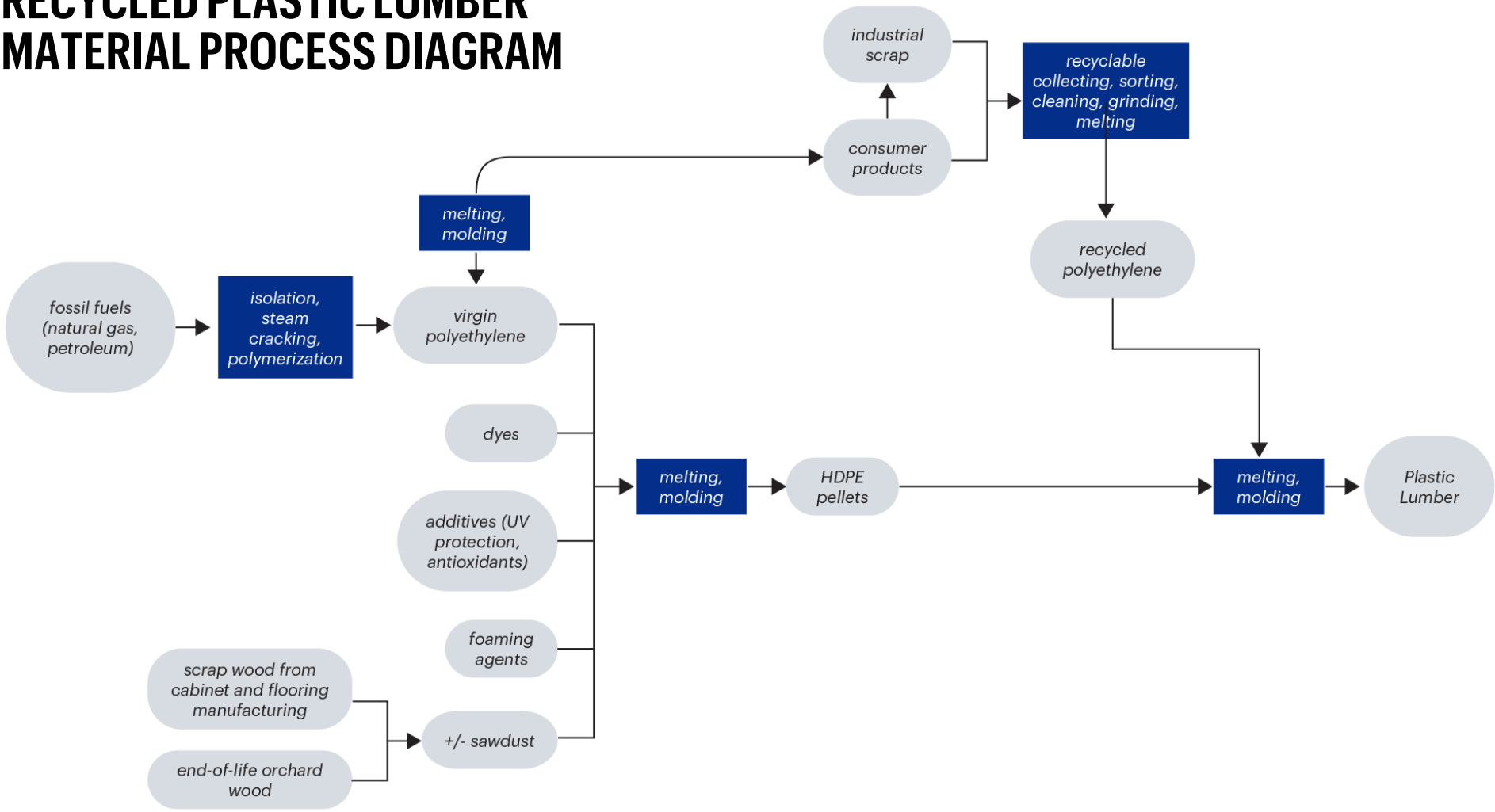
Figure 5.41, Recycled Plastic Lumber Samples. Credit MNLA

that cause ethylene to form strands. Depending on the conditions (including pressure) in which polymerization takes place, it results in either HDPE or LDPE. From here, polyethylene (PE) resins are extruded or molded into products. At their end of life, or if the product of industrial waste, these PE products can be recycled by melting down and re-extruding.

The plastic lumber companies we investigated make varying claims about the level of recycled content in their products, ranging from undisclosed to "some" to as high as 95%. Total recycled content includes both *post-consumer* and *post-industrial* waste. Post-consumer content, generally what one imagines when one imagines recycled content, is an amalgam of discarded goods that have already served their use and been consumed in a market of exchange. Post-industrial content (also called pre-consumer) comes directly from factory waste before being turned into a consumer product – think factory trimmings and other scrap. These definitions should ensure that pre-consumer polyethylene is truly industrial waste of a third-party company and not the careless, excess production of industry.[1]

As considerations of sustainability have become more widely accepted and promoted in the corporate world, recyclable waste has become a commodity. There is a competitive market for recycled plastic, in particular, high-grade post-consumer HDPE. One manufacturer we worked with mentioned that

RECYCLED PLASTIC LUMBER MATERIAL PROCESS DIAGRAM



Sample mapping of plastic lumber manufacturing process.

New graphic based on content from:

Jfranzen. "Understanding How HDPE Is Made." Tangent, 12 Oct. 2022, tangentmaterials.com/understanding-how-hdpe-is-made/

"How Is Plastic Lumber Made? – Plastic Lumber Yard." | 100% Recycled Lumber Pulled From Landfills, plasticlumberyard.com/how-is-plastic-lumber-made/. Accessed 18 June 2025.

Figure 5.42, Recycled Plastic Lumber Process Diagram, Credit MNLA

several years ago they needed to reduce the amount of recycled HDPE in their product from 100% to 25% because the growing competition among all industries for materials marketed as sustainable had caused prices to become too expensive for them to ensure 100% recycled content. Traditionally, recycled LDPE has been a less coveted commodity among RPL manufacturers, as LDPE is weaker than HDPE and needs to be combined with wood fibers to make a sound RPL product. With the growth of companies like RPL7, that market too is increasingly competitive (according to an interview with RPL7). RPL7 has cultivated a wide network of sources to meet its demand for recycled LDPE, including programs to collect discarded LDPE from industrial, commercial, and community partners.

Manufacturer Engagement and Data Access Challenges

The acronym for this family of materials is RPL1, RPL2, and so on. This investigation encompassed seven RPL companies, many of which were initially chosen from NYC Parks specifications and their approved manufacturers list. None of the companies filled out the Manufacturer's Questionnaire, though four provided pointed pieces of information (such as safety data sheets and responses to direct email questions) when repeatedly contacted. As the research advanced, the scope expanded and contracted, and it ultimately became most fruitful to focus on two companies: RPL1 and RPL7.

Corporate Social Responsibility Profile

RPL1 argues that its products offer sustainable options for building. It supplies most of the RPL used in NYC Parks' benches, as the agency appreciates its durability, ease of maintenance, and the fact that it is partially recycled.[2] Interestingly, NYC Parks specifications require RPL slats to include at least 90% recycled material, even if they appear to give manufacturers significant leeway, because few if any suppliers can reach the 90% benchmark. In practice, this is more an aspirational target than a legally binding specification.[3] RPL1 uses a third party to certify their recycling practices: they published and shared with our research team documentation certifying that their product contains at least 17% recycled content. All this content is certified as "pre-consumer," and none as "post-consumer," meaning the content is industrial plastic waste rather than, for instance, household milk jugs. They purchase this content from commodity recyclers – companies that buy waste and re-sell it. RPL1 was unwilling to share further details about the locations of the commodity recyclers they use. If RPL1's product uses 17% recycled content, what about the other 83%? When asked directly about the origins of their virgin HDPE, RPL1 held that this information is proprietary. Moreover, RPL1 has not produced EPDs or HPDs for their products. And hence, the information we have for evaluating the Corporate Social Responsibility of RPL1, leaves us with significant gaps that need to be critically examined. Though RPL1's factories are noted as located in the United States and Canada, the full supply chain of its products suggests that some materials are sourced from much farther afield.

The other company, RPL7, has a major footprint nationwide and a supply chain that makes for an interesting comparison with RPL1. NYC Parks does not specify RPL7 because it contains wood fibers that the agency fears could hold moisture and warp after years of wear.[4] We chose to include the company in our analysis because they were mentioned frequently in our Survey for Landscape Architects, indicating that they are used by other jurisdictions with some frequency.

RPL7 emphasizes the R in RPL, claiming that its composite decking is made from 95% recycled or reclaimed materials.[5] A third party named International Code Council verifies this claim. Specifically, it shows that RPL7's boards are made of 16.7% pre-consumer recycled polyethylene, 31% post-consumer recycled polyethylene, and 47.7% pre-consumer recycled wood. As noted in public informational materials and direct communication, RPL7 sources its polyethylene (PE) from commercial and industrial partners such as factories, shippers, and stores that wrap their goods in plastic film. Community partnerships offer another source of PE, as RPL7 deploys branded drop-off boxes and encourages students to hold recycling drives to collect plastic bags and film.[6] These community programs are widely marketed by RPL7 as significant anchors of their sustainability initiatives. This results, however, in collecting roughly one percent of RPL7's PE. In personal communication with company representatives, RPL7 explained that nearly all its recycled PE comes from the US, with a small portion from Canada.[7] They have also "looked into" sourcing this product from Mexico and banana-producing countries (collecting the plastic bags used to transport the fruit), both with limited success. The wood fibers, meanwhile, come from furniture and flooring manufacturers' scrap wood and orchard trees at the end of their useful lives. These materials are all combined and extruded at RPL7's factories, which are all in the United States.

Figure 5.43, Recycled Plastic Lumber Picnic Tables. Credit MNLA

RPL7 has not produced EPDs or HPDs for their products. Though the origins of much of their material can be accounted for through the recycling paths described above, gaps remain around chemical additives, for the small portion of virgin PE used in the RPL, and the aluminum and PVC components used in its other non-RPL product lines. PL7 asserts that most of these additional elements are sourced in the US (including the Gulf Coast for chemical resins), but approximately 5% of its total ingredients, by cost, comes from overseas. Aluminum and steel from Europe and Asia are notable examples.

For any discussion of recycling, one must also remember that recycled content is not automatically ethical. Though difficult to trace in this study, it is certainly possible that workers who collect and process recyclable material face exploitative working conditions.

Forced Labor Risks for Recycled Lumber

The Material in the News:

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component as RPL1 to RPL7)

Plastic lumber has been the subject of news items over the past decade. In the city of New York, it made headlines alongside another material far more notorious—Brazilian hardwood. Indeed, the increased and near exclusive adoption of RPL in NYC is part attributable to growing public concern with the environmental costs of harvesting slow-growing tropical trees such as ipe, from the Amazonian forest. Very strong and highly resistant to rot and surface abrasions, ipe has been a popular material for decking and outdoor furniture. When specified in 2008 for New York City's much celebrated Highline project, protests abounded.[8] Then Mayor Bloomberg issued a 19-page Memorandum, "Tropical Hardwood Reduction Plan," which set out to investigate the environmental risks of using such a material.[9] It is now well known that harvesting this wood is environmentally destructive, and attempts to certify certain tropical hardwood operations as sustainable have met controversy. In 2009, protests at NYC's Highline condemned the use of ipe and amid the outcry, NYC committed to reducing the city's use of tropical hardwood by 20%,[10] not before, however, a significant campaign by the wood industry to gain favor in the Highline dispute. This odd blog post, written by "Mr. Ipe Hardwood" in October 2009, suggests there is no more robust and resilient material for NYC.[11] It did come to pass that NYC Parks categorically stopped using tropical hardwood, for their benches.[12] RPL filled the void.

With increased public awareness about the perils of tropical hardwood, RPL companies have positioned their product as a more sustainable alternative. According to their advertisement campaigns, not only does it avoid cutting down trees, but it also closes the loop on plastic waste streams. There may be merits to these claims, though as discussed above, from some products the actual level of recycled content can be underwhelming.[13] Replacing wood with a highly manufactured plastic, sourced from toxic petrochemicals, raises important questions. Durability is one such question. NYC Parks considers RPL longer lasting and easier to maintain than natural wood but avoids composite RPL that includes wood fibers. This type of composite decking has had durability issues in the past, including lawsuits against manufacturers related to mold and flaking.[14] More relevant to this study, however, are questions of supply chain ethics.

What does Sayari reveal?

Where we reach the limits of what manufacturers are willing to disclose, we turn to the supply chain mapping software Sayari. This side of the investigation shows risks in the supply chains of several of our companies.

- RPL 3, RPL4, and RPL5 are plastic lumber companies with none or extremely limited records in Sayari and as such we could not evaluate the risk of forced labor in their supply chains.

- RPL6, is a plastic lumber company with a limited data footprint in Sayari. What could be gleaned from its profile, however, is that while it does not, currently, indicate a direct risk of forced labor, this company has multiple sources of Elevated Forced Labor Risk at its third tier of one of its supply chains. One of its second-tier companies has seven different suppliers that have Elevated risks. This attributes to our company a risk level of yellow.

- RPL1, is a plastic lumber company with a limited data footprint in Sayari. What could be gleaned from its profile, however, is that while it does not, currently, indicate a direct risk of forced labor, this company has two sources of Elevated Forced Labor Risk at its second tier of supply chains. One company receives shipments of glass fibers, paper and paper boards, iron or steel wires, sewing machine needles and machinery parts imported from Ecuador and it receives significant shipments of polyethylene. This attributes to RPL1 an inherited risk level of orange for forced labor.

- RPL2, is a large is a manufacturing outfit in the building material industry, with an extensive data profile in Sayari. Because it is was impossible to parse out which of the exact supply chains was related to plastic lumber, which is a small component of their larger portfolio, we've simply identified that as a company they have many divisions with a direct Elevated Forced Labor risk in its supply chains.

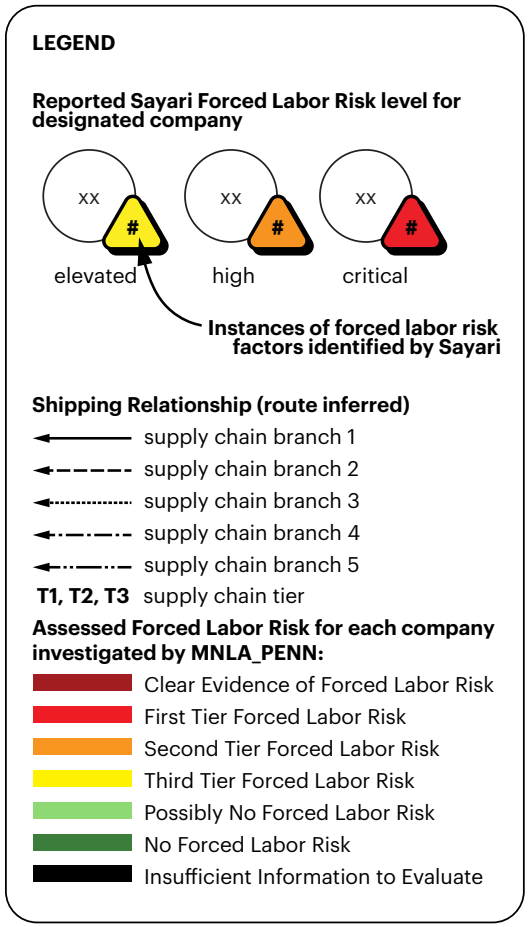
- RPL7, is a plastic lumber company with an extensive data profile in Sayari. This company claims to use 95% recycled content yet supply chain risks for forced labor persist. It is identified by Sayari as being at direct Elevated Forced Labor risk in four of its supply chains. One line of risk comes from its import of aluminum and PVC products possibly used in railing systems that the company sells alongside its RPL. Shipment records show that PL7 buys aluminum from a Spanish company (acronym Architectural Products Co. 1 (APC1)). APC1 buys polyvinyl chlorine (PVC) from a petrochemical company owned by a Xinjiang-based entity that was named in the Sheffield Hallam report on PVC. In this way, APC1 *inherits* a level of risk by doing business with an entity flagged for forced labor, and PL7 inherits some of that risk from APC1. Though records suggest that PL7 only purchases aluminum from APC1, it is possible that some of this aluminum is coated with PVC. (PL7 uses PVC in several of its railing products, and its origin has not been verified.) A second line of Elevated Forced Labor risk is in PL7's purchase of machinery from a company in India with inherited risk from Xinjiang. A third line of Elevated Forced Labor risk is in PL7's purchase of plastic boards and packaging material from another company in India that makes plastic protective fabrics and that purchases its materials from an entity in Xinjiang, doing business with LG Chem and Xinjiang Blue Ridge. It is unclear how exactly PL7 uses the material it purchases from the fabric company. One could speculate that it is scrap to be recycled, or virgin material to be used in a product. A final line of High Forced Labor risk is via a Mexican based company that sources vinyl chloride products from BASF and Sinochem International.

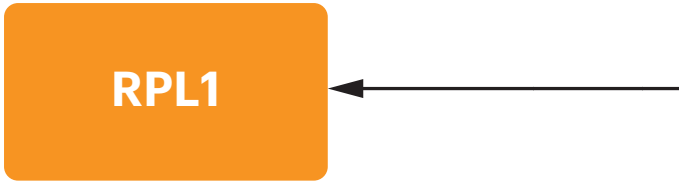
Both RPL2 and RPL7 carry a level of inherited risk from their first, second and third tiers of their supply chains. Either via raw polymer materials or machinery, we see risk of forced labor hidden deep within the artificial grain of RPL. The highly visible use of recycled materials, does not therefore, automatically shield these products of forced labor risk that is commonly inherited from complex petrochemical supply chains.

Diagram of Global Supply Chain Risk

RPL1

This image is a partial mapping of RPL1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.





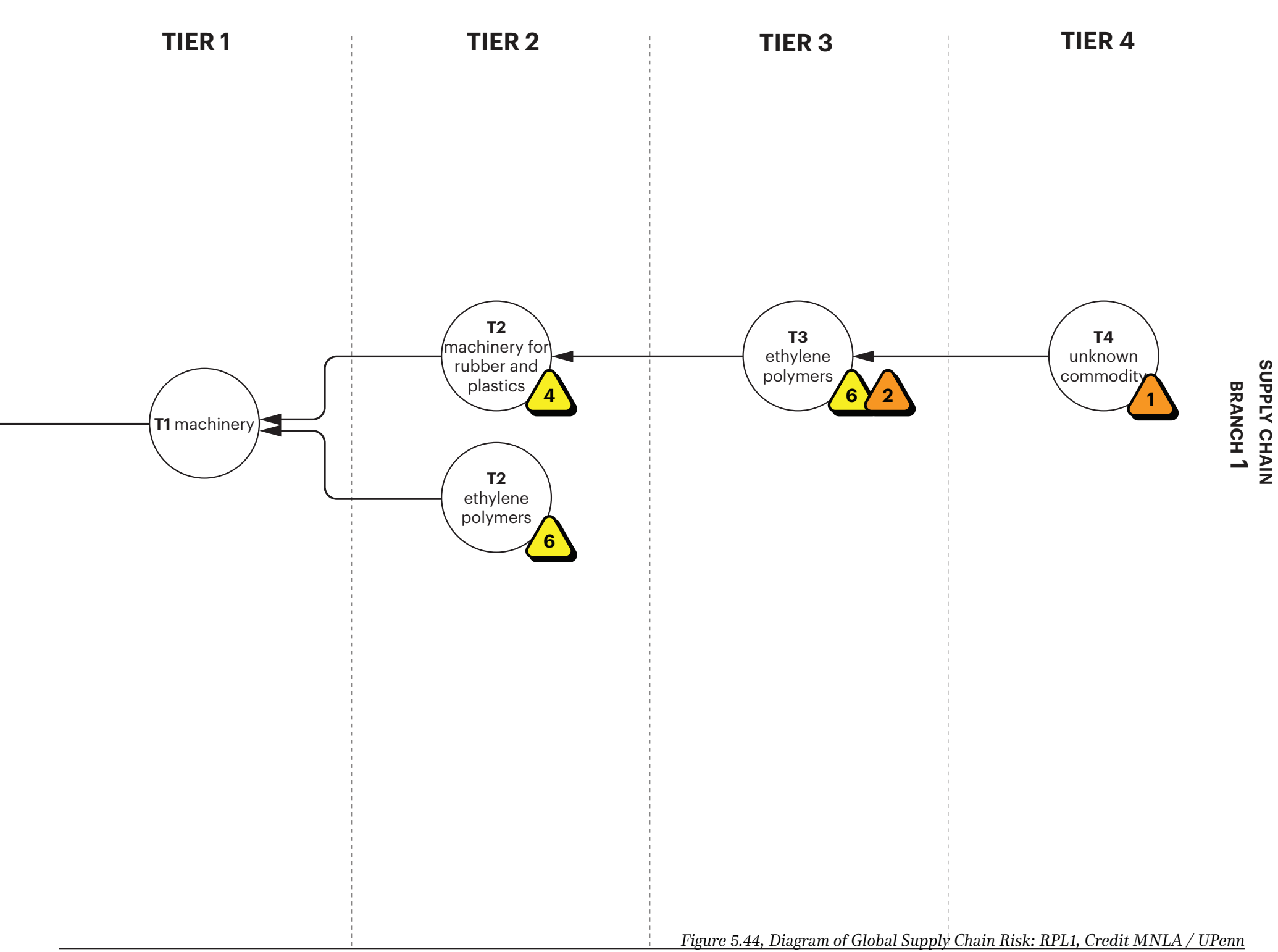


Figure 5.44, Diagram of Global Supply Chain Risk: RPL1, Credit MNLA / UPenn

Shipping Map of Global Supply Chain Risk

RPL1

This image is a partial mapping of RPL1's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.

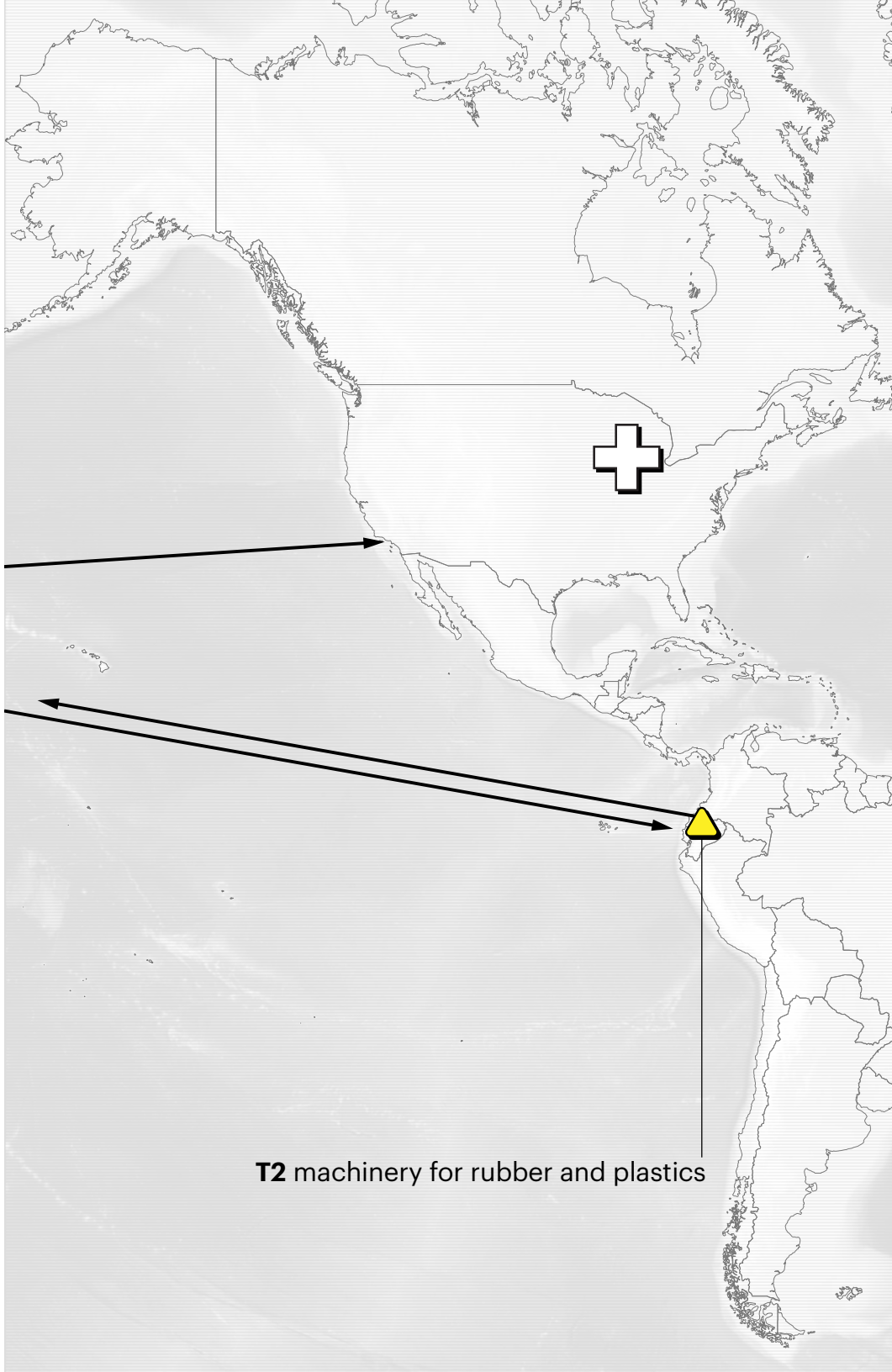
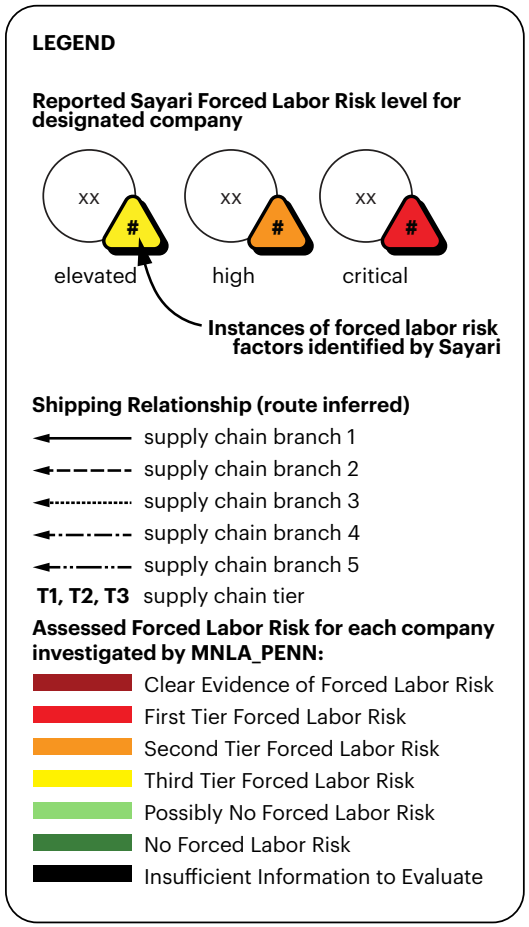


Figure 5.45, Shipping Map of Global Supply Chain Risk:RPL1 Credit MNLA / UPenn

Diagram of Global Supply Chain Risk

RPL7

This image is a partial mapping of RPL7's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com.



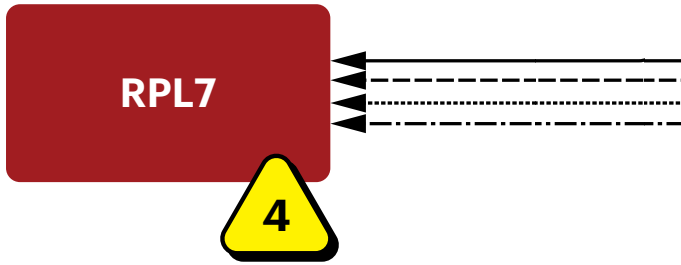
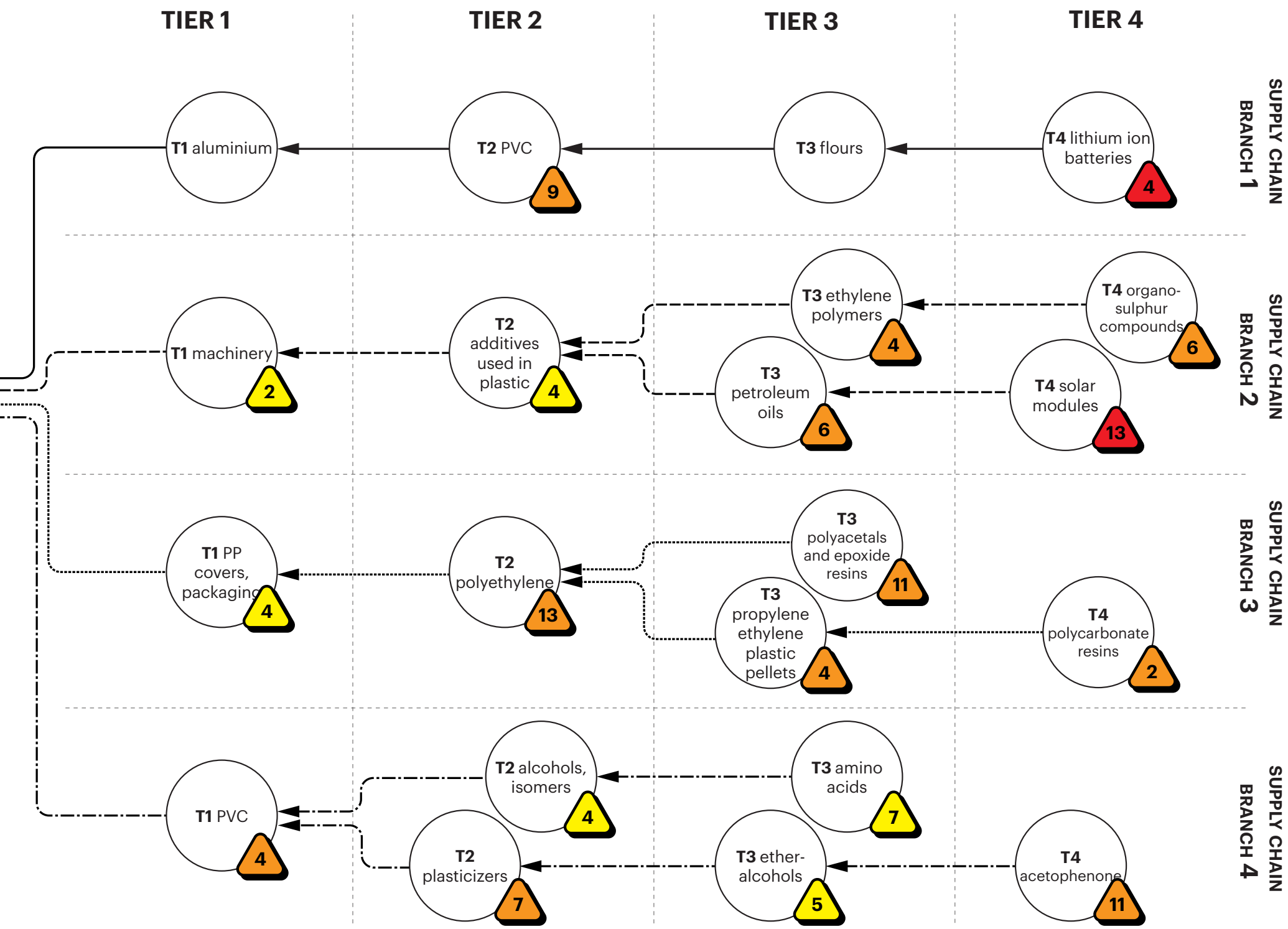


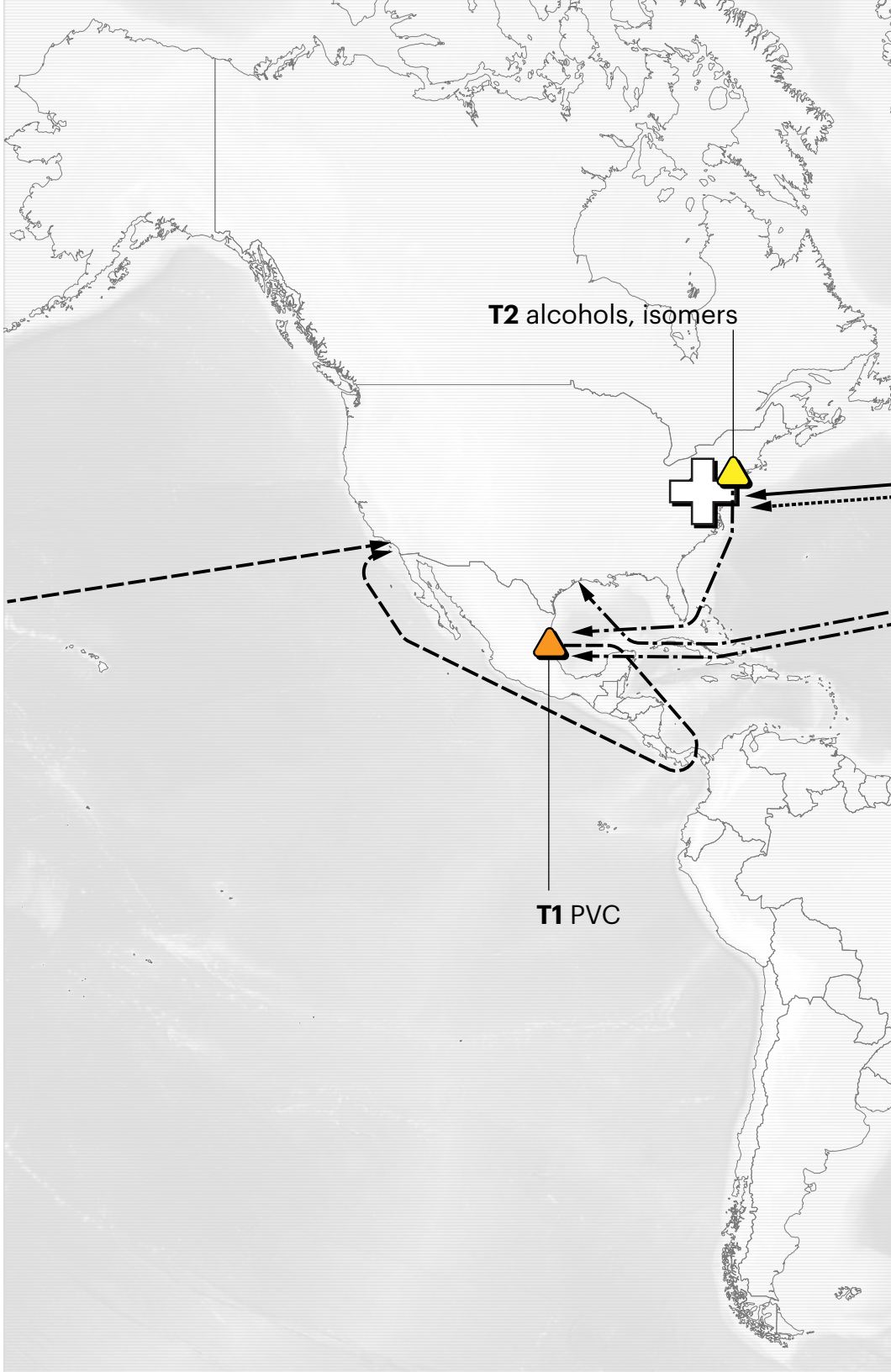
Figure 5.46, Diagram of Global Supply Chain Risk: RPL7, Credit MNLA / UPenn


TIER 1
TIER 2
TIER 3
TIER 4
SUPPLY CHAIN BRANCH 1
SUPPLY CHAIN BRANCH 2
SUPPLY CHAIN BRANCH 3
SUPPLY CHAIN BRANCH 4
T1 aluminium
T2 PVC
9
T3 flours
T4 lithium ion batteries
4
T1 machinery
2
T2 additives used in plastic
4
T3 ethylene polymers
4
T3 petroleum oils
6
T4 organo-sulphur compounds
6
T4 solar modules
13
T1 PP covers, packaging
4
T2 polyethylene
13
T3 polyacetals and epoxide resins
11
T3 propylene ethylene plastic pellets
4
T4 polycarbonate resins
2
T1 PVC
4
T2 alcohols, isomers
4
T2 plasticizers
7
T3 amino acids
7
T3 ether-alcohols
5
T4 acetophenone
11

Shipping Map of Global Supply Chain Risk

RPL7

This image is a partial mapping of RPL7's supply chain, showing only those suppliers who are flagged in Sayari as at risk for forced labor exposure. It was produced using anonymized sample data, both current and historical (as early as 2019), of forced labor risks in the supply chains of said companies, as generated by Sayari.com. Mapped with ESRI and Google Maps.



LEGEND

Reported Sayari Forced Labor Risk level for designated company

elevated | high | critical

Non-Sayari Map Symbols

no reported forced labor risk

manufacturer headquarters

Shipping Relationship (route inferred)

- supply chain branch 1
- supply chain branch 2
- supply chain branch 3
- supply chain branch 4
- supply chain branch 5

T1, T2, T3 supply chain tier

Assessed Forced Labor Risk for each company investigated by MNLA_PENN:

- Clear Evidence of Forced Labor Risk
- First Tier Forced Labor Risk
- Second Tier Forced Labor Risk
- Third Tier Forced Labor Risk
- Possibly No Forced Labor Risk
- No Forced Labor Risk
- Insufficient Information to Evaluate

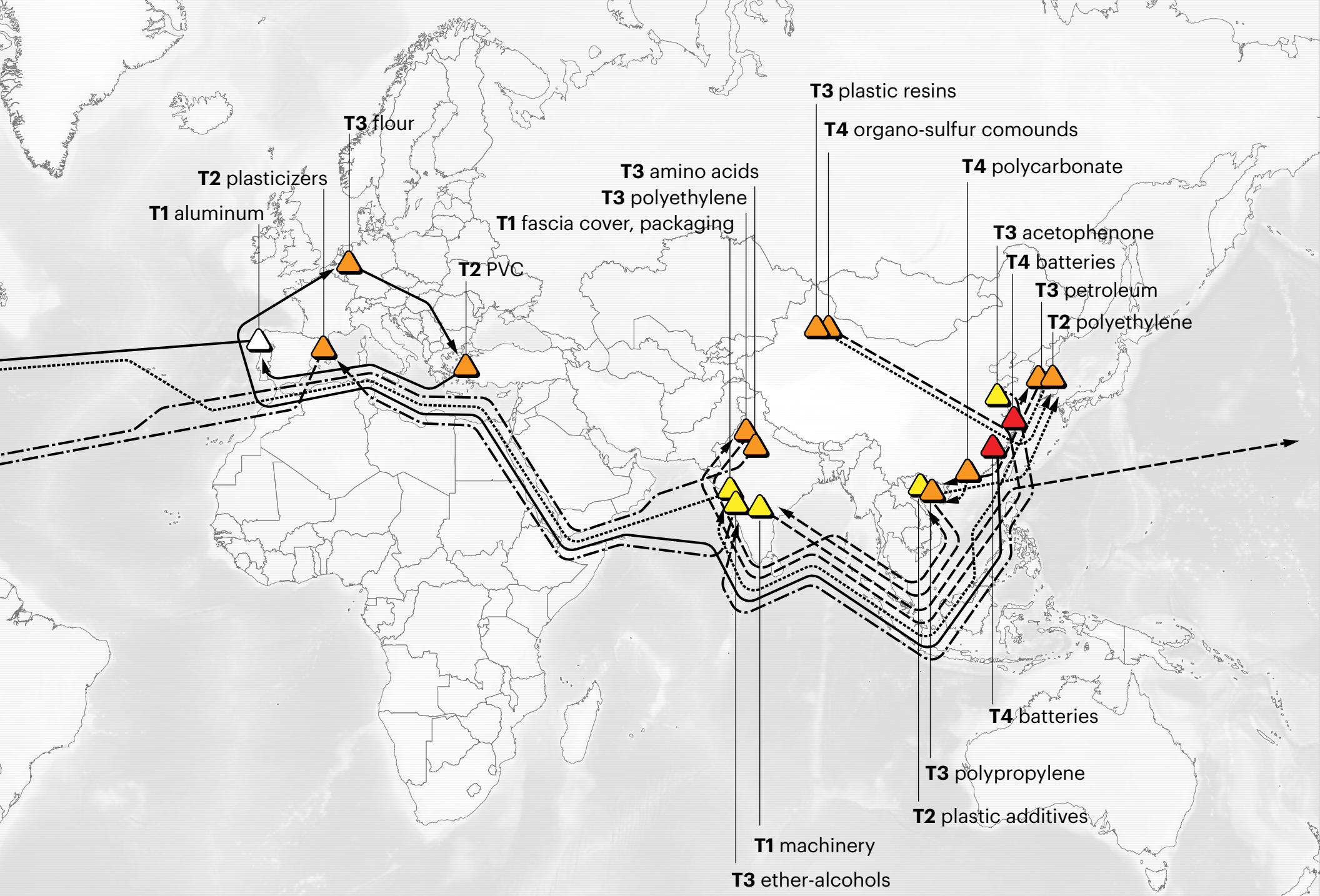


Figure 5.47, Shipping Map of Global Supply Chain Risk:RPL7 Credit MNLA / UPenn

Endnotes

[1] Jenn Engstrom and Cleste Meiffren-Swango, "Turning plastic waste into plastic lumber isn't recycling", *Beyond Plastic*, PIRG, March 20, 2024, https://pirg.org/articles/turning-plastic-waste-into-plastic-lumber-isnt-recycling/

[2] Zoom conversation between MNLA and NYC Parks, Director - Specifications and Estimating, April 8, 2025.

[3] NYC Parks Standard Specifications and Zoom conversation between MNLA and NYC Parks, Director - Specifications and Estimating, April 8, 2025.

[4] Zoom conversation between MNLA and NYC Parks, Director - Specifications and Estimating, April 8, 2025.

[5] Microsoft Teams conversation between MNLA and RPL7 representative, August 19, 2025.

[6] Data furnished by RPL7 representative.

[7] Microsoft Teams conversation between MNLA and RPL7 representative, August 19, 2025.

[8] Billy Parker, "High Line Called Out For Using Amazon Wood," *Gothamist*, September 24, 2009, https://gothamist.com/news/high-line-called-out-for-using-amazon-wood.

[9] Mayor Michael R. Bloomberg, "Memorandum, Tropical Hardwood Reduction Plan", NYC , February 11 2008, https://www.nyc.gov/html/om/pdf/tropical_hardwoods_report.pdf

[10] Joseph Berger, "A Fight Over Keeping Boards in the Boardwalk," *The New York Times*, July 1, 2011, https://www.nytimes.com/2011/07/02/nyregion/fighting-over-rain-forest-ipe-in-coney-island-boardwalk.html

[11] https://blog.advantagelumber.com/2009/10/27/central-park-benches-ipe/

[12] Jane Hutton, "Ipe is the most common tropical hardwood decking material in the United States, but the way it is harvested has raised concerns among," *Landscape Architecture Magazine*, May 19, 2013, ecologistshttps://landscapearchitecturemagazine.org/2013/05/17/a-trail-of-stumps/

[13] Jenn Engstrom and Cleste Meiffren-Swango, "Turning plastic waste into plastic lumber isn't recycling", *Beyond Plastic*, PIRG, March 20, 2024, https://pirg.org/articles/turning-plastic-waste-into-plastic-lumber-isnt-recycling/

[14] RTT News Staff Writer, "Trex Settles Class Action Lawsuit - Quick Facts," RTT News, July 31 2009, https://www.rttnews.com/1024441/trex-settles-class-action-lawsuit-quick-facts.aspx?Arch=1. See also, "Trex® Surface Flaking Class Action Settlement, Ross, Hureth, et al. v. Trex Company, Inc., Case No. C 09-670 JF, United States District Court for the Northern District of California, San Jose Division, https://www.trex.com/legal/classactionsettlement.aspx

This Page Is Intentionally Left Blank

6.0
Designer and Researcher Agency

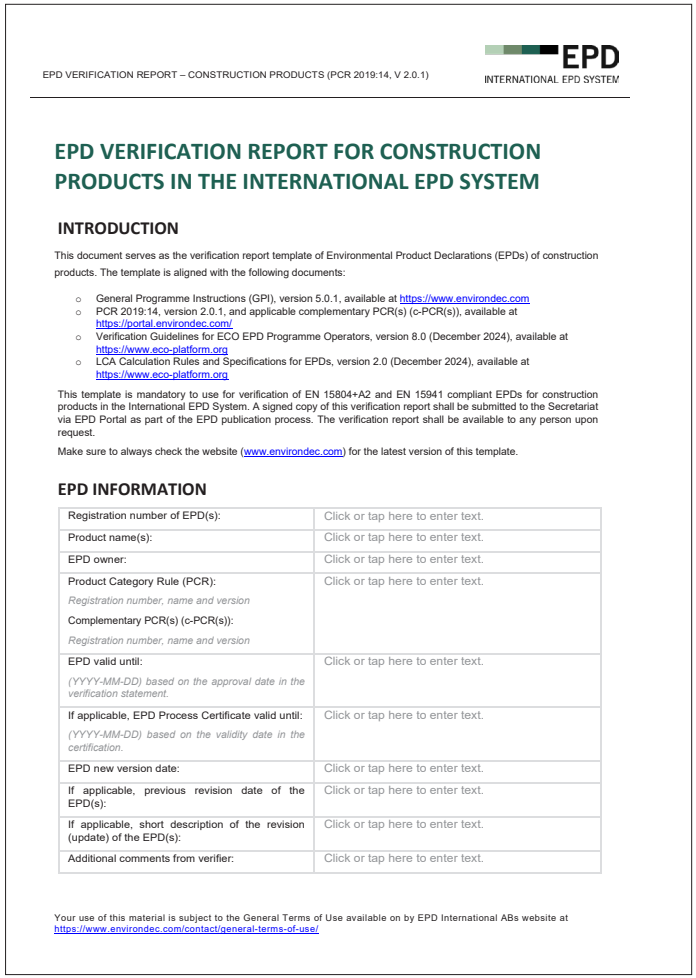
6.1.1 ENVIRONMENTAL PRODUCT DECLARATIONS (EPDS)

Currently, NYC Parks requires mandatory performance standards for the construction products they specify as put forth by the American Society for Testing and Materials, known as ASTM standards. ASTM standards are not however equivalent to Environmental Product Declarations (EPDs) which speak to a product's potential contribution to global warming, greenhouse gas emissions, and CO2. Since the Paris Climate Agreement in 2015, the Mayor's Office of New York has issued an executive order requiring that construction industry manufacturers provide EPDs, for their products on all New York City projects.[1] EPDs include material product information necessary to calculate a product's carbon footprint through manufacturing and transportation. While EPDs focus on environmental impact, particularly robust ones can also potentially offer insight into raw material sourcing, transportation, product chemistry, and manufacturing facility locations.[2]

An important question our team asked each manufacturer was: "Does your product have an EPD?" Three manufacturers did share EPDs upon request, and at least one noted they were currently developing EPDs. The majority of the 34 companies we investigated, however, do not have EPDs available for their products. Where we were in contact with companies, representatives sent Material Safety Data Sheets or ASTM results, which provided some information on material chemistry but did little to answer questions around labor.

The contrast is stark between the transparency requirements for the food and fashion industries as compared to the construction industry. While the US Food and Drug Administration requires an ingredients list and nutrition label on food products sold within our country, our team asks why neither the public, nor designers are afforded this kind of clarity on the materials that we come into contact with daily in our built environment.[3]

Currently, NYC Parks is piloting a new requirement for manufacturers to provide steel and concrete EPDs in response to the Mayoral Executive Order NO. 23 dated September 22, 2022.[4] As mentioned above, this aligns New York City agency construction agendas with the goals set forth by the Paris Agreement to reach climate net-zero carbon emissions by 2050. The mayoral order acknowledges that 8% of global greenhouse gas emissions come from cement manufacturing and 7% come from steel manufacturing worldwide.[5] This requirement will allow city agencies to compare the carbon footprint of these products against each other and measure the carbon footprint of each project more accurately. While the executive order was meant to take effect immediately, updating NYC Parks procedures takes time.



EPD VERIFICATION REPORT – CONSTRUCTION PRODUCTS (PCR 2019:14, V 2.0.1)

EPD INTERNATIONAL EPD SYSTEM

EPD VERIFICATION REPORT FOR CONSTRUCTION PRODUCTS IN THE INTERNATIONAL EPD SYSTEM

INTRODUCTION

This document serves as the verification report template of Environmental Product Declarations (EPDs) of construction products. The template is aligned with the following documents:

- General Programme Instructions (GPI), version 5.0.1, available at https://www.environdec.com
- PCR 2019:14, version 2.0.1, and applicable complementary PCR(s) (c-PCR(s)), available at https://portal.environdec.com/
- Verification Guidelines for ECO EPD Programme Operators, version 8.0 (December 2024), available at https://www.eco-platform.org
- LCA Calculation Rules and Specifications for EPDs, version 2.0 (December 2024), available at https://www.eco-platform.org

This template is mandatory to use for verification of EN 15804+A2 and EN 15941 compliant EPDs for construction products in the International EPD System. A signed copy of this verification report shall be submitted to the Secretariat via EPD Portal as part of the EPD publication process. The verification report shall be available to any person upon request.

Make sure to always check the website (www.environdec.com) for the latest version of this template.

EPD INFORMATION

Registration number of EPD(s):	Click or tap here to enter text.
Product name(s):	Click or tap here to enter text.
EPD owner:	Click or tap here to enter text.
Product Category Rule (PCR): *Registration number, name and version* Complementary PCR(s) (c-PCR(s)): *Registration number, name and version*	Click or tap here to enter text.
EPD valid until: *(YYYY-MM-DD) based on the approval date in the verification statement.*	Click or tap here to enter text.
If applicable, EPD Process Certificate valid until: *(YYYY-MM-DD) based on the validity date in the certification.*	Click or tap here to enter text.
EPD new version date:	Click or tap here to enter text.
If applicable, previous revision date of the EPD(s):	Click or tap here to enter text.
If applicable, short description of the revision (update) of the EPD(s):	Click or tap here to enter text.
Additional comments from verifier:	Click or tap here to enter text.

Your use of this material is subject to the General Terms of Use available on by EPD International ABs website at https://www.environdec.com/contact/general-terms-of-use/

Figure 6.01, EPD Verification Report Template, Credit https://www.environdec.com/services/epd-templates

6.1.2 FAIR LABOR STATEMENTS

As part of our study, we monitered the inclusion of fair labor statements on the websites of our case study companies. The United Kingdom's Modern Slavery Act (2015), Canada's Fighting Against Forced Labour and Child Labour in Supply Chains Act (2024), and Australia's Modern Slavery Act (2018) have required manufacturers to publish an anti-slavery and human trafficking statement on their website and include a link to the statement in a prominent place. In America, a state level supply chain rights law, the California Transparency in Supply Chains Act of 2010, also requires this statement on manufacturers' websites for those companies wishing to do business in the state of California.[6]

Of the thirty-four 34 companies whose products we investigated, only two companies, RPL7 and GEO5 publicly states their compliance with the California Transparency Act on their website with a fair labor statement. However, more generally, twenty percent (20%) of our companies condemn forced labor in public statements on their websites in some form. Based on this study's 5 material product categories fair labor statements were provided on the websites of: 0 of the 7 Safety Surfacing (SS) companies, 0 of the 7 Synthetic Turf (ST) companies, 1 of the 7 Permeable Paving (PP) companies' websites had fair labor statements, 3 of the 7 Recycled Plastic Lumber (RPL) companies' website and 3 of the 5 Geotextile (GEO) companies' websites.

Notably, some companies with global profiles and multiple subsidiaries have multiple versions of their website, each accommodating regionally specific policies. For example, a policy statement against modern slavery for Mapei, an adhesive, sealant and chemical company (not reviewed as part of this research) can be found on their UK specific website. At the bottom of the website one can find MAPEI's Modern Slavery Statement featured alongside the other social and sustainable policies with respect to UK law. The USA specific MAPEI website does not have this information, nor any social sustainability statements.[7]

Public statements promoting environmental sustainability are more common than those condemning forced labor with forty-five percent (45%) of the company websites we studied indicating concern for the environment in some way. Most notably, while only one permeable paver company and one synthetic turf company from our study provided public statements against forced labor, 5 of each of these two company types provided statements promoting sustainability. Statements against forced labor can sometimes be found within a sustainability section of a company's website as the two issues are often associated.

6.1.3 CERTIFICATIONS

In addition to EPDs, a third-party certification is another way for companies to disclose their environmental and/or social impacts and potentially attract customers and buyers. One recycled plastic lumber (RPL) manufacturer from our study, for instance, promoted its adherence to LEED standards and shared documentation from a third-party verifier certifying a certain percentage of recycled content. Certifying bodies play an important role in aiding manufacturers in the process of providing material transparency, as manufacturers often use a legal process through which to offer their data to the public.

There is no global standard fair labor certification process, and currently fair labor audits come in various forms of rigor and objectivity. Self-assessments and self-statements are the weakest form of audits. These come as client input, member networking, and self-administered surveys. Third party audits that occur continually and involve in-person field inspections at the source of mining and/or fabrication are the most effective. Third party audits can also be based on interviews from afar, but these are less effective. The consistency and thoroughness of such assessments can vary a great deal between certification types. Blind spots on the part of the auditors is also a common issue.

Fair labor certifications require different levels of commitment from manufacturers and provide varying degrees of auditing oversight that designers should be aware of. Some certifications recognize a single product, others a single manufacturing facility, and others recognize a whole company. Few certifications recognize a company or product's entire supply chain across all tiers.

Our research team remains skeptical about the efficacy of most certifications given the lack of transparency and systemic rigor in their execution. The research of author Laurie Parsons who in his recent book, *Carbon Colonialism* (2023), describes the ineffectiveness of corporate certifications, is vital.[8] On multiple fronts, Parsons conveys how certifications are often not reliable indicators of the true risk that a material supply chain may incorporate forced labor. Often incriminating data is not picked up in a single field audit as the targeted interviewees may hold back information due to company intimidation tactics. In addition, it's not always certain how thorough audits are completed across a company as Parsons found that labor ethics may vary across departments in each factory.

Our research team recognizes that the terrain of fair labor certifications is very complex and utilizing them is not a silver bullet for safeguarding against forced labor in the supply chain of material products. Because it's difficult to compare and select appropriate fair labor certifications, theyare easily dismissed or glossed over by sales representatives, especially if forced labor is not a company priority. When we asked a stone sales representative about their company's fair labor certifications during a "lunch and learn", the answer was disappointingly vague. They believed that one of their sustainable certifications included fair labor regulations but didn't have the name of the certification readily available. Upon further research on our part, we identified that the company had achieved certification through the Natural Stone Institute, which in the end does not evaluate or confirm the presence of fair labor in a product's supply chain other than to request self declarations that no forced labor or child labor exists in their company.[9] This stone certification is given to employees who indicate competence in handling the material.

Certifications acquired by the companies we investigated

The companies we investigated did seek industry certifications beyond ASTM standards, even if sparingly. These additional certifications most often referenced environmental sustainability standards. None of our companies obtained certifications that focus solely on fair labor. This is not surprising to us as plastic is a key material focus in our 5 material products of study. While it wasn't our intention to prioritize plastics in our research, all five material products consist of, or integrate, petroleum chemical compounds in their material makeup. This list even includes concrete permeable pavers and paver jointing mortars which use plasticizers in their manufacture. As the *Design for Freedom International Guidance and Toolkit* states, there are no certifications currently available that specifically audit the plastic industry against forced labor.[10]

In the category of environmental certifications, Synthetic turf (ST) manufacturers obtained the most, followed by Safety Surface (SS), and Recycled Plastic Lumber (RPL). Only one Permeable Paver (PP) company obtained an additional certification, that is now expired, which includes fair labor requirements. Lastly, none of the geotextile manufacturers in our study sought certifications beyond ASTM standards.

SELF-REPORTED SUSTAINABILITY RATINGS ATTAINED BY THE INVESTIGATED COMPANIES

Permeable Paving (PP) companies

- EcoVadis (expired)

Geotextile (GEO) companies we investigated self-reported attaining no sustainability certifications

Synthetic Turf (ST) companies we investigated self-reported attaining:

- Cradle to Cradle Bronze, version 3.1
- 450+ONE Certification
- Greenguard
- FloorScore
- IPEMA Certificed USADA Certified Biobased Product
- USDA BioPreferred Program
- USDA Certified Biobased Product Label

Satefy Surface (SS) companies we investigated self-reported attaining

- FSC GPSNR
- FloorScore
- European Standard

Recycled Plastic Lumber (RPL) companies we investigated self-reported attaining:

- Green Circle Certified
- ICC-ES Environmental for Determination of Recycled Content of Materials
- LEED For Homes (2008)

Sustainability ratings with a component of forced labor rights

Permeable Paving (PP) companies we investigated self-reported attaining:

- EcoVadis (expired)

Synthetic Turf (ST) companies we investigated self-reported attaining:

- Cradle to Cradle Bronze version 3.1 : One ST company received a Silver for Social Fairness however Cradle to Cradle does not provide further information on how this was achieved.
- 450+ONE Certification

Satefy Surface (SS) companies we investigated self-reported attaining

- FSC GPSNR

Standards of interest identified by USGBC and barriers to their use

While our sample size was small, our Survey to landscape professionals included respondents from across the United States with their answers indicating general national trends within the profession. Based on responses to this question, "Which metrics do you encourage?", LEED and SITES were by far the leading answers. Based on this data, our team reviewed both LEED and SITES to assess whether either encourage fair labor practices as part of their credit systems.

Neither SITES nor LEED include credits associated with fair labor in supply chains within their main credit categories. LEED, however, has been experimenting with including this type of credit since 2015.[12] Currently it is possible to receive a LEED credit for using two "permanent materials" on a project that have been verified by eight of the International Labor Organization's (ILO) Conventions or by using pre-verified supply chain standards. The full requirements for this credit can be found in the LEED Social Equity within the Supply Chain Pilot IPpc144.[13] This pilot is offered for a limited time as a trial. Should professionals start to use it, this credit or a version of it could be offered permanently.

A list of the pre-verified certifications that meet the ILO standards is supplied by the LEED Social Equity within the Supply Chain Pilot. Our team reached out to two members of the LEED Materials and Resources committee to understand more about how the certifications were pre-verified, but we did not receive a response.

We compared the LEED pre-verified standards available to a US based landscape architect in our associated matrix. A list of all the pre-verified certifications appear on the left. They are divided into two groups: certifications that cover a manufacturing company and those that cover products. Factors applicable to the landscape profession are assessed in the columns to the right including the standard's material focus, applicability to the landscape architecture profession, whether they are actively auditing manufacturing companies in the United States, and what type of assessment they offer.

Many of the landscape applicaple standards are most actively certifying companies outside of the US. The report includes screenshots taken from a sampling of the pre-verified certification websites in which they map the companies that have achieved their certifications and where they are located across the globe. Notably, United States companies demonstrates limited use of most of these LEED approved certifications.

Therefore, obtaining this LEED credit would be difficult for landscape architects in the US as this might require importing fair labor certified products from abroad. Importing certified fair labor products from long distances is against general sustainable principles of using local products to reduce carbon emissions in material transportation. On the other hand, our research shows that many so called "American Made" products also include raw materials shipped from overseas (for example, the polymer yarn threads that go into making geotextiles) and hence, it is not a given that "American Made" products have lower carbon emissions than those made abroad. Designers should be discerning on this regard and when balancing the carbon footprint of importing fair labor products vs. percieved local products.

In addition, importing certified fair labor products can include longer lead times and incur greater costs to the project due to shipping. Since according to our survey for landscape architects, lead times and cost play a much more significant role in the mindset of a landscape designer than fair labor currently, it makes sense that using products with these obtained certifications are not a priority for US based landscape architects.

Client willingness to require certifications

Requiring certifications in specifications and contract documents may not be simple depending on the landscape architect's client. For example, by law, NYC Parks cannot require manufacturers to obtain certifications because this would create a bias toward companies with greater financial means to obtain them. NYC Parks can specify that manufacturers either obtain a certain certification or that they prove compliance with that certification's standards without having to purchase it.[14] In this scenario, a certification's fair labor requirements, such as Xertifix's, could provide important benchmarks for the industry. However, it would be remarkable if a given manufacturer could match Xertifix's third-party auditing process, without paying another auditing body a similar fee. Private clients may have more capacity to include fair labor certification requirements in their contracts and may also be able to pay for them should they desire them.

LEED PRE-VERIFIED ILO COMPLIANT STANDARDS OF POSSIBLE USE TO LANDSCAPE

	Pre-Verified ILO Compliant Standards by USGBC to Audit Organizations	Material or Industry Concentration?	Is the Standard Associated with Landscape Construction?	Does this Standard Audit US Based Companies?	Standard Type?	Website
1	Aluminum Stewardship Initiative Performance Standard (v2)	Aluminum	yes	yes	Certification	https://aluminium-stewardship.org/about-asi/members?operation=United%20States
2	Concrete Sustainability Council Certification (v2.0)	Concrete	yes	no	Certification	https://csc.eco/
3	Ethical Trading Initiative (ETI)	Fashion	no	unclear	Membership	https://www.ethicaltrade.org/
4	Fair Labor Association ® (FLA)	Fashion	no	yes	Accreditation	accreditation/
5	Fair Stone Standard (4th ed)	Stone	yes	no	Partnership	https://www.en.fairstone.org/contact-us/
6	Global Impact Sourcing Coalition's (GISC) Impact Sourcing Standard	Fashion/Tech/Finance	no	yes	Membership	https://www.bsr.org/en/collaboration/groups/global-impact-sourcing-coalition
7	Initiative for Responsible Mining Assurance Certification (IRMA-STD-001) (2018)	Minerals	yes	yes	Rating System	https://responsiblemining.net/resources/#community-resources-toolkit-english
8	Rainforest AllianceTM Sustainable Agriculture Certification - Supply Chain Requirements (2020)	Wood	yes	no	Certification	https://www.rainforest-alliance.org/for-business/certification/sustainable-agriculture-certification/
9	ResponsibleSteel Certification (v3.0)	Steel	yes	yes	Certification	https://www.responsiblesteel.org/certification
10	SA8000 Standard (2014)	(see Note 1)	no	yes	Certification	https://sa-intl.org/programs/sa8000/
11	SGE 21 Ethical and Socially Responsible Management System (2017)	(see Note 1)	no	unclear	Standards	https://standardsmap.org/en/factsheet/158/overview
12	World Fair Trade Organization's (WFTO) Fair Trade Standard (v4.2)	Furniture	no	yes	Verification Label	https://wfto.com/
13	XertifiX Standard Certification	Stone	yes	no	Certification	https://www.xertifix.de/handel/map/?lang=en
14	Copper Mark Certification	Copper	no	yes	Recognition	https://coppermark.org/
	Pre-Verified ILO Compliant Standards by USGBC to Audit Products					
1	Aluminum Stewardship Initiative Chain of Custody Standard (v1)	Aluminum	yes	yes	Certification	https://aluminium-stewardship.org/about-asi/members?operation=United%20States
2	BRE: BES 6001 Responsible Sourcing of Construction Products Standard (v3.1)	Construction Industry	yes	no	Certification	https://bregroup.com/services/standards/sourcing
3	BRE: BES 6002 Ethical Labour Sourcing Standard (v1) – Level One	N/A - no longer in use	n/a	n/a	n/a	No longer in use
4	Concrete Sustainability Council Certification (v2.0)	Concrete	yes	no	Certification	https://csc.eco/
5	Cradle to Cradle Certification - Silver (v4.0) or Gold (v3.1) Level in Social Fairness	Construction Industry	yes	yes	Certification	https://cdn.c2ccertified.org/resources/certification/C2CC_v3.1_to_v4_comparison_FINAL_031121.pdf
6	Fair Trade USA® Trade Standard (v2.0)	Furniture	no	yes	Certification	https://www.fairtradecertified.org/
7	Forest Stewardship Certification CoC	Wood	yes	yes	Certification	https://us.fsc.org/en-us/certification/chain-of-custody-certification
8	Global GreenTag Certification (v4.1) – Bronze Level	Any Product	yes	yes	Certification	https://www.globalgreentag.com/about.html
9	Global Recycle Standard (v4.0)	Any Product	yes	yes	Standard	https://www.scsglobalservices.com/
10	ResponsibleSteel Certification (v3.0)	Steel	yes	yes	Certification	https://www.responsiblesteel.org/certification

Legend

Landscape	Landscape Architecture Applicable Standard
Landscape	Standard Not Applicable to Landscape Architecture

Note:

1. Standard is available for any company but not actively used in the building industry.

Figure 6.02, LEED Pre-verified ILO Complient Standards, Credit USGBC

6.1.4 WHAT CAN SPECIFICATIONS DO/NOT DO?

Why specifications?

At the conclusion of the design process, Landscape Architects issue legally binding contract documents which encompass drawings and specifications. Specifications are detailed written documents to describe the quality, materials, methods and scope of work for a construction project. Both the drawings and specifications provide the contractors with clear instructions, ensuring quality adherence to the standards, and the fulfillment of the design intent. In the event of a discrepancy between the drawings and specifications, specifications take precedence over the contents of the drawings.

Structure of specifications

If the project is following government agency-established specifications, the format of the specifications will be unique to that agency. However, most other project specifications will follow the industry-established CSI (Construction Specifications Institute) format. If the project is following CSI-format for specifications, the specification sections will be categorized in 50 Divisions. Division 01 will establish the administrative, procedural, quality control, safety, sustainability, and project-level performance requirements. It could also include requirements for Ethical Labor Standards such as the ones DFF has begun to develop. The DFF Toolkit includes a framework for Division 01 specifications with their "Section 018113.63 – Ethical Design Requirements". This section includes definitions of forced labor, an Ethical Materials Tracking Schedule as well as ethical design submittal requirements.

The other Divisions (02-50) focus on existing conditions and specific materials, and landscape architects will find many of their specifications in Division 32, Exterior Improvements. Through discussions with the client and owner, the design team has to work to determine if Ethical Design Requirements will be applied project-wide or to specific divisions or sections.

The specification sections are further divided into three parts:

1. Part 1: General Requirements – including scope of work, standards, submittals and quality assurance.
2. Part 2: Products – specific product names and manufacturers or performance requirements for products.
3. Part 3: Execution – how the work should be performed.

Through our research, we found very few products that can be confidently specified as forced-labor-free due to complexity of the supply chains and the composite nature of many of the products we investigated which trace back to various raw materials. This makes including specific products in Part 2 challenging, if not impossible. Furthermore, if working on a project for a government agency, often proprietary products cannot be specified. Since Part 3 describes how the construction is executed on site, we focused our attention on how we could address ethical labor concerns in Part 1.

Working Language for Part 1 (see sample specification that follows)

In order to gain information on the ethical sourcing materials, we can insist that manufacturers disclose their supply chains in Part 1 of our specifications. We can insist that contractors procure this information as part of the construction process. We start by asking for information. Many manufacturers may not be familiar with the supply chain or on its implication of ethical sourcing, but they can find out. The more frequently we ask, and the more landscape architects who engage in this practice, the more awareness will be raised about the ethical labor in the products that we specify.

We can also require manufacturers to provide a statement on Modern Slavery and remind contractors that they must be following the Uyghur Forced Labor Prevention Act (UFLPA) and Fair Labor Standards Act (FLSA)[15].

While we did not find robust certifications and products free of forced labor in our research, we as a professional community can begin to ask for the information that will eventually ensure these come to fruition.

Sample Specifications Language

If ethical labor is being addressed project-wide in Division 1, the following language would be incorporated into DFF Section 018113.63 - Ethical Design Requirements.[14]

In the context of design disciplines, it is customary to incorporate each discipline's specification sections into the project-wide specifications. It is imperative to acknowledge that the ethical labor language cannot be addressed in Division 1 in the absence of an agreement with all disciplines. The incorporation of ethical labor provisions accompanied by stipulation language within Division 1 could be a viable option.

Alternatively, we can initiate the incorporation of the following language in Part 1 of our specification section without inclusion in Division 1.

Under the heading "Action Submittals":

A. Ethical Design Submittals:
    1. Supply Chain Documentation:
        a. Provide verifiable evidence of supply chain to 3rd tier [or 5th tier].
        b. If any product at any tier of the supply chain is determined to show a connection to unethical labor, as defined in Section 018113.63 – Ethical Design Requirements, or under "Definitions" above, the following measures shall be taken:
            i. If found by the:
                a. Contractor: then the contractor shall notify the client and landscape architect in writing.
                b. Landscape architect: then the landscape architect shall notify the client and contractor in writing.
            ii. Product shall not be allowed on site.
            iii. Investigate alternate products.

Under the heading "Information Submittals":

A. Manufacturer Submittals:
    1. Provide manufacturer's Modern Slavery Statement.
    2. Provide certifications related to Fair Labor (i.e.,Xertifix for natural stones), see Section 5.

Create a heading related to ethical design that reinforces existing laws related to fair labor:

A. Ethical Design Regulations:
    1. Products shall comply with the Uyghur Forced Labor Prevention Act (UFLPA).[15]
    2. Projects shall comply with Fair Labor Standards Act (FLSA).[16]
    3. All other local, state and federal laws shall apply.

In our proposal, the research team initially set out to answer the question: *How can we, as landscape architects, have a positive, catalytic impact on advancing fair labor practices through writing project specifications and refining procurement practices?*

This research has revealed that the current certifications and laws are not adequate enough to write into our specifications and absolve us of the responsibility of ensuring our work is not built on the back of unethical labor. Our research indicates that no single product can be confidently manufactured without any risk of forced labor. It is evident that the industry is facing significant challenges and requires substantial attention. The following chapter explores what agency we have as designers to establish an awareness that will eventually drive change.

Specification Diagram

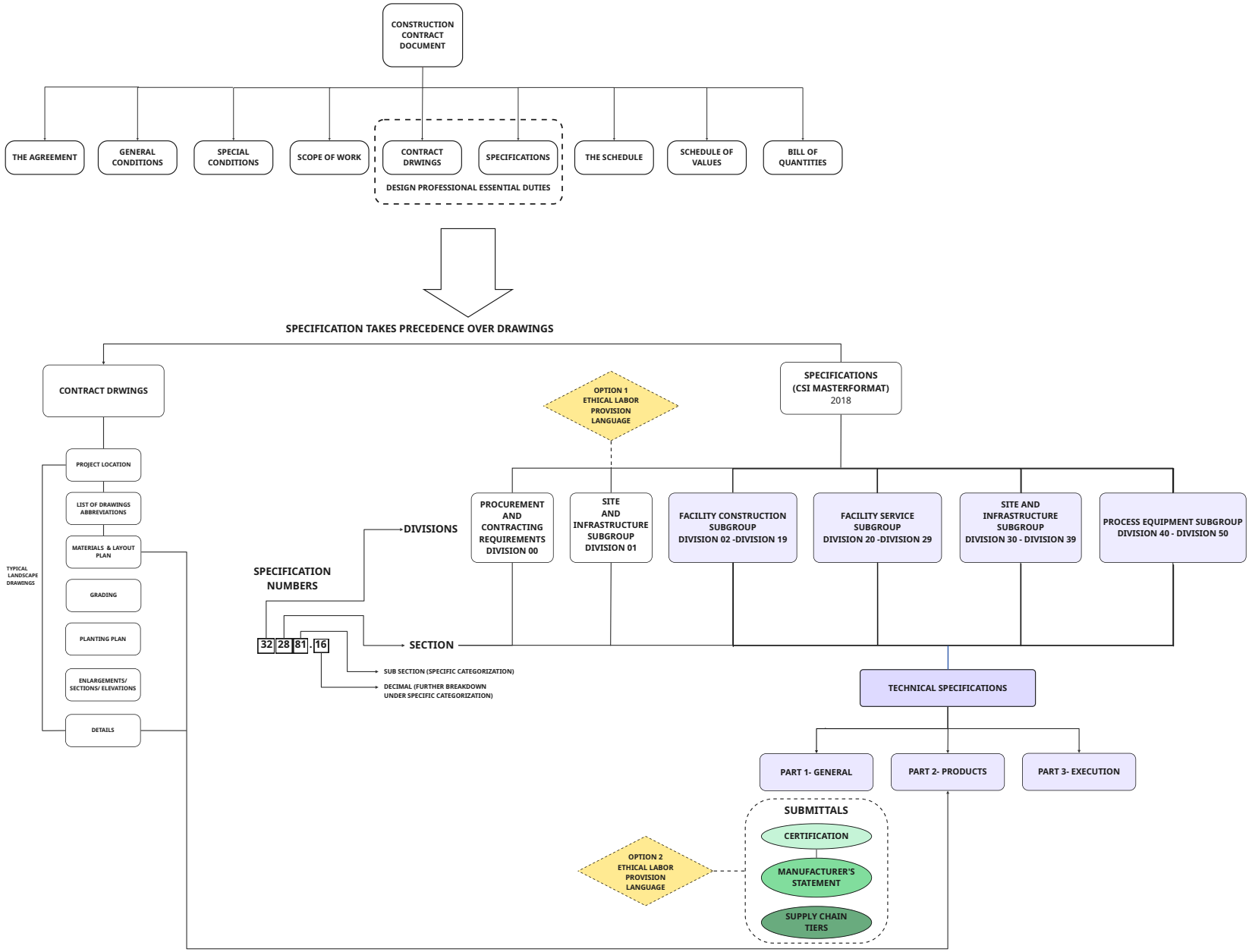


Figure 6.03, Specification Diagram and Ethical Labor Provision Language, Credit MNLA

Endnotes

[1]NYC.gov, "Executive Order 23", September 22, 2022, https://www.nyc.gov/mayors-office/news/2022/09/executive-order-23

[2]For an overview on EPDs, see "EPD Basics: A Manufacturer's Guide to How and Why to Develop an Environmental Product Declaration" , EPA, Office of Chemical Safety and Pollution Prevention, December 2024, https://www.epa.gov/system/files/documents/2024-11/epd_basics_how_why_to_develop.pdf

[3]Food and Drug Industry Labeling Regulations: https://www.ecfr.gov/current/title-21/chapter-I/subchapter-A/part-1; Apparel Industry labeling Regulationshttps://www.ftc.gov/news-events/topics/tools-consumers/apparel-labeling

[4]NYC.gov, "Mayor Adams Signs Executive Order to Cut Greenhouse Gas Emissions From City Construction Projects". September 23, 2022, https://www.nyc.gov/mayors-office/news/2022/09/mayor-adams-signs-executive-order-cut-greenhouse-gas-emissions-city-construction-projects

[5]Ibid

[6]State of California, Department of Labor, "The California Transparency in Supply Chains Act," https://oag.ca.gov/SB657

[7]For the UK site, https://www.mapei.com/gb/en/home-page; for the US site, https://www.mapei.com/us/en-us/home-page

[8] Laurie Parsons, *Carbon Colonialism, How rich countries export climate breakdown,* (Manchester University Press, 2023)*; 57-75.*

[9] Natural Stone Institute, "Accreditation, The natural stone industry's third party verified qualified labor credential for countertop fabricators and commercial installers." https://www.naturalstoneinstitute.org/programs/accreditation/accreditation/

[10] Grace Farms Foundation. Design for Freedom Toolkit. Grace Farms, 2023. https://www.designforfreedom.org/wp-content/uploads/2023/12/DFF-Toolkit-Download.pdf

[12]LEED launches social equity pilot credits: https://www.usgbc.org/articles/leed-launches-social-equity-pilot-credits

[13]Social Equity within the Supply Chain Pilot credit[s]: https://www.usgbc.org/credits/IPpc144-v41

[14]New York City Public Procurement Rules: https://www.nyc.gov/assets/mocs/downloads/Regulations/PPB/PPBRules.pdf

[15]The Uyghur Forced Labor Prevention Act, or UFLPA was signed into law as the U.S. response to the Chinese government's systemic use of forced labor against Uyghurs and other ethnic minorities in the Xinjiang Uyghur Autonomous Region (XUAR) in the Peoples's Republic of China. https://www.cbp.gov/trade/forced-labor/UFLPA

[16]The Fair Labor Standard Act (FLSA) establishes minimum wage, overtime pay, recordkeeping, and youth employment standards affecting employees in the private sector and in Federal, State, and local governments. https://www.dol.gov/agencies/whd/flsa

6.2 LAWS AND LOBBYING

Laws

Mechanisms are available to both designers and researchers interested in eradicating forced labor in the design and building industry, including laws, supply chain mapping tools, or reports from civil society, reporters, and NGO investigators.

United States Legislation identifies what our country is allowed to import. The US Trade Facilitation and Trade Enforcement Act of 2015, prohibits the importation of goods manufactured with forced labor into the United States.[1] In addition, the Uyghur Forced Labor Prevention Act of 2021 (effective 2022), legislates that goods mined, produced, or manufactured wholly or in part in Xinjiang or by an entity on the UFLPA list are prohibited from importation.[2] Between the years 2022 and 2025, 1,361 shipments of industrial and manufacturing materials were detained at US shipping ports, and 1,067 shipments were denied. The denied shipment material was valued at $72,999,533.[3] This product detainment undoubtedly caused project delays and project budgets to increase if not balloon. Designers should warn project owners of this possible risk early in the design process to mitigate the effects of such an occurrence. On a moral front, designers and researchers also need to be aware that while these laws stop some goods suspected of being produced with forced labor at US borders, as our study has shown, many at risk products still enter most likely due to the fact that supply chain transparency is often suppressed. Therefore, further mitigation tactics are required to build forced labor free. Landscape architects should warn clients of both these risk factors.

For designers and researchers to advocate effectively, they should inform themselves of areas where there is documented risk of forced labor in material sourcing and fabrication across the globe, and educate their clients, design and build teams, and students. They should also continually request support for the resources and for the time it will take to ensure fair labor practices occur in today's built environment.

Lobbying, the case of "Know the Chain"

Designers and researchers can also aid global humanitarian investigators who study corporate supply chains and who have achieved success in other manufacturing spaces. Important in this regard is the UK's Business and Human Rights Resource Centre's fair labor data resource, "Know the Chain" that identifies, measures, and evaluates the practices of well-known consumer companies. The mandate of the Business and Human Rights Resource Centre is to:

- *Support collective worker empowerment*
- *Adopt a worker-centric approach to due diligence*
- *Conduct Risk assessment (including safe engagement with workers affected or potentially affected)*
- *Offer grievance mechanisms and supplier monitoring*
- *Lend public support for the development of mandatory human rights and environmental due diligence (mHREDD) regimes and robust Modern Slavery Acts"*[4]

The Business & Human Rights Resource Centre has successfully reviewed the electronics, fashion, and food industries. They have done this by creating an easy to interpret set of graphic charts that communicates the calculated risk of forced labor for each company they've studied. For example, for the apparel footwear industry, they score companies as Lululemon, Puma, Adidas, Nike, Ralph Lauren, Asics and others.[5] For the food and beverage industry they reviewed Woolworths, Tesco, Hershey, Walmart, Coca-Cola, Danone, PepsiCo, and others.[6] And lastly, for the information and communications technology sector, they reviewed Samsung, Cisco systems, Apple, Intel, Logitech, Nokia, and others.[7]

The simple question is: why are companies who produce an incredible array of products used in the construction of the built environment not evaluated in a similar way? The easy answer is that most citizens do not know the name of the companies that supply us luxury flooring, gypsum board, or ceiling tiles. Designers, researchers and builders can lobby the organizers and facilitators of the "Know the Chain" scoring and ranking system, to turn their attention to the built-in environment. We are all aware of major producers in this space. Our research in the supply chain of landscape architecture material products has identified two dozen companies which could be investigated using the same tools as used for the clothing industry. In addition, we can easily identify significant material suppliers in companies such as DOW, Johns Manville, Tyvek, Hilti, Dupont, BASF, Pella, Anderson Windows, Kawneer, Kingspan, Saint Gobain, Rockwool and many more who are "household" names for most designers and builders. This is something that we can all lobby for and champion with the goal of gaining greater agency in our supply chains.

6.3 WHAT CAN DESIGNERS DO?

Over the course of this research, it has become apparent that the act of specifying a certified product is only one element of a designer's agency within a project's manifestation. More critical than writing the specification itself, is the designer's consistent engagement with clients, stakeholders, consultants and contractors in seeking support for the extra resources it will take to ensure the use of fair labor building products in each project. One of the most impactful moments of the designer's agency occurs right at the beginning of a project in which a collective agenda is founded. This agenda could prioritize fair labor in several specific ways throughout a project right from the beginning. Client education and engagement on this topic early in the project's process is essential as key moments will surface in later phases of a project in which a designer can advocate for fair labor materials by reminding everyone of this established commitment.

Designers should frame the case for fair labor products as the right thing to do, acting in tandem with current US policy, and also as an act of preventing the possibility that a project's budget suffers large increases and a great timeline delay in the event that material products are stopped at the border due to the inclusion of forced labor in their supply chains.

At the start of a project, a designer can do the following to gain the client's support for the effort it will take to include fair labor sourced materials throughout the rest of the project's development:

1. Engage your design team
    a. Inform yourself, the designer and the rest of your design team of the current labor risks in the built environment.
    b. Review the issues that might arise as you seek to source fair labor materials in the later stages of the project.
    c. Anticipate ways in which you see your project needing the client's support to advocate for fair labor.
2. Engage the Client
    a. Educate/Discuss the priorities of the project and advocate for including building with forced labor free materials.
    b. Identify the extra resources/time it may take to do so
        i. Certification audit costs
        ii. Material alternate sourcing principles
        iii. Allowing project delays to source fair labor products
        iv. Higher cost for fair labor free materials
        v. Specification additions to request supply chain transparency and fair labor certified products
3. Encourage the signing of a building contract with explicit principles of fair labor sourcing.

Critical path for evaluating materials and products at risk for forced labor

If seeking to specify a single material (wood, aluminum, steel, stone, etc):

1. Consult the US department of Labor, List of Goods Produced with Forced Labor, for any countries which should be avoided given their high incidence of forced labor risk for the material being specified. https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-goods
2. Consult the Business and Human Rights Resource Center, including the Know the Chain Network, https://www.business-humanrights.org/en/from-us/knowthechain/
3. Identify if your materials have been the source of targeted investigations that are registered in open source data.
4. Consult the Walk Free Foundation for world assessments using various data interfaces, https://www.walkfree.org/global-slavery-index/map/
5. Consult Verité and their Responsible Sourcing Tool, https://www.responsiblesourcingtool.org/identify/
6. Consult references such as The Design for Freedom Guidance and Toolkit, https://www.designforfreedom.org/home/design-for-freedom-international-guidance-toolkit/ and the COOKFOX, "Survey of Labor Certifications for the Built Environment"
7. Identify material specific certifications for investigation as they exist for wood, stone, copper, and aluminum.
8. Evaluate what percentage of the total building material this material represents and whether this puts the project at significant risk

If specifying material products, that are traceable to a company:

1. Look for adverse media on the company, including forms of litigation published in the Business & Human Rights Resource Centre, https://www.business-humanrights.org/en/, and any open source data.
2. Ask the company if they are willing to share Tier 1 information with you.
3. Consult the UFLPA list of banned companies, https://www.dhs.gov/uflpa-entity-list
4. If the material or material product is a polymer, polymer blend, or composite, then evaluating its risk for forced labor requires a third-party supply chain management outfit.
5. If any part of the product includes a synthetic polymer (made from petrochemical sources from the Xinjiang region of China) or natural rubber or palm oil (West Africa or Indonesia), there is little chance to certify it is free of forced labor.
6. If the product represents a small contract amount, this decreases the exposure to risk, but it also reduces the chances that you can afford to research its supply chain.
7. If a company has a published third party certified EPD or HPD, or equivalent certification, this could reduce the probability of forced labor in its supply chain.
8. You can search for EPD, HPDs, or other certifications within Building Ease, http://buildingease.com
9. You could require only companies with EPD/HPDs bid on the project

Add Fair Labor to your list project goals alongside sustainability:

1. Our research survey demonstrated clear priorities among landscape architects across the country. Sustainability is a major area of focus for designers. Landscape architects should include fair labor.
2. When considering the carbon footprint of a material product, scrutinize of the labor practices present at the raw material's extraction site.

6.4 WHAT CAN RESEARCHERS DO ?

Researchers in various disciplines have investigated the question of forced labor in material supply chains for years. This has certainly been the case in the clothing industry and agro-industries, where food products such as shrimp, tomatoes, and palm oil have been the subject of extensive analysis. The Bibliography included in this report offers a comprehensive analysis of the state of research today, as well as the role forced labor plays in design and the larger built environment.

Given the highly bifurcated nature of the construction industry and the minimal resources it accords to research, little time and effort are dedicated to understanding where our materials come from and how their manufacturing impacts the environment and that of human labor.

What can researchers do to increase the amount of data, knowledge, and recognition of this topic amongst those who wish to study its causes, conditions, and impacts?

When engaging the Academy:

1. Place the built environment, front and center, amongst the questions that must be addressed by rigorous academic investigations. It is often the case that the built environment, its buildings and materials, are seen as the "obvious" output of economic imperatives that have little to teach us about their origins, motivations, or import. A brick is more than just a brick, its production having a great deal to teach us about our desires, values, and conflicts.

2. Encourage students to focus on how the built environment comes into being. The "how" of building is motivated by impulses and forces rarely discussed in professional curricula, but important to address when seeking to communicate who benefits and who is harmed by building.

    a. Economic and corporate relationships underpin the built environment; these must be considered when deciding which companies are featured in building contracts.

    b. Legislative initiatives are equally important to surveille when considering materials and their origins. How might we evaluate the impact of laws, policies, and guidelines in changing the building culture of labor remains an important subject of research.

When engaging the Building Industry:

1. Identify areas of analysis for which there is little data or transparency when it comes to material supply chains, including why it is that so few companies produce EPDs or HPDs in support of greater communication.

2. Share with building industry professionals (designers, engineers, and builders) the various resources that companies have available to them to help them identify who their suppliers are.

3. Help members of the building industry identify the material supply chains at most risk, and for whom they pose the greatest risk.

4. Find willing partners in the building industry who wish to collaborate in asking important questions about which supply chains on a given project are most at risk.

5. Invite building industry product suppliers and large-scale construction management companies to enter into research agreements, that allow them to investigate the multiple tiers in the material supply chains of key materials in select projects.

When engaging the research subject, in general:

1. Adopt investigative techniques and practices to help identify data sources hidden to most clients, building professionals, and the public. A great deal of the information is publicly available, however, recognizing where this content can be accessed involves adopting an investigative stance more akin to journalism than academic research.

As an example of how and where research can contribute to wider recognition of the subject amongst those who practice in the building industries, our Penn researcher has investigated forced labor in building for several years. For this project, they've focused more particularly on identifying the supply chains of five ground cover materials typical to playgrounds, sports fields, and outdoor recreational sites.

Published texts that capture this research and highlight the research questions and methods adopted in support of this project:

- Franca Trubiano, "Forced Labor in Building Material Supply Chains – Evaluating Risk in Specifying Architectural Materials," *Conference Proceedings, EAAE/ARCC CONFERENCE 2024 – Architecture into the Unknown*, (Aarhus, DK, 2024).
  This first paper identifies the question of human rights and its relationship to construction labor.

- Franca Trubiano, Noriko Maeda, Ivanna Dudych, "Covering Ground: Identifying the Risk of Forced Labor in Five of the Most Specified Landscape Architecture Materials in the US," *Conference Proceedings, ICSA International Conference, 2025, University of Antwerp.* (Antwerp, Belgium, 2025).
  This second paper asks about the origins of most polymers used in the building industry.

- Franca Trubiano, "You Found Forced Labor in your Material Supply Chain: Now what?" Volume Three of *Building Better – Less – Different*, "Sustaining Labor and Transforming Cities", Volume Editor, Fall 2025
  This final paper discusses what landscape architects can do when they identify that the products they're using have been sourced and manufactured using forced labor.

6.5 ARE WE WILLING TO DO SOMETHING IF WE SEE SOMETHING?

As we become ever more aware of the possibility of forced labor in our building material supply chains, via research, news report, and investigative journalism we are faced with this important question: **Are we willing to do something if we see something?**

If, and when faced with this question, we encourage all to read this report and consult many of the important resources identified in the bibliography and literature review.

In addition, as professionals, we might be more sensitized to the problem if:

1. We were exposed to a third-party supply chain management report for a building material that identifies forced labor in its supply chain.

2. We review the Business and Human Rights Resource Centre Companies Database and find a company whose products we intend to specify for an upcoming project cited as being at risk (https://www.business-humanrights.org/en/companies/)

3. We identify a material from the "US Government List of Products Produced by Forced or Indentured Child Labor," https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-products/ that we intend to specify for an upcoming project.

4. We identify a material product on a US Customs and Border Patrol Sanctions list of the UFLPA list, https://www.dhs.gov/uflpa-entity-list, that we intend to specify for an upcoming project.

5. We are working on a building project in a global location that has a high risk of forced labor, as per the resources discussed in this report.

6. We witness evidence of forced labor on a construction site, or in the use of material products for which we have evidence of the use of forced labor.

If you are a designer, architect, or landscape architect, and you have evidence of forced labor in the material supply chain of a material:

1. You can author specifications that encourage the client to seek third-party certification for forced free labor materials and material products for a significant monetary value of the contract.

2. You can advise the owner, client, and contractor of your evidence and request that they choose an alternate material.

3. You can reject a material submittal offered by a contractor and request that they choose an alternate material.

4. You can halt the project and take the time to find new material sources

5. You can inform the product manufacturer, supplier, and distributor of this evidence.

6. You can share the evidence of forced labor in the material supply chain of the material product with allied professionals and the public.

If you are an owner, client, or client representation, and you have evidence of forced labor in the material supply chain of a material.

1. You can support designers in rejecting the submittal that asks for approval of said material.

2. You can approve the request for additional time to find new sources.

3. You can be willing to assimilate the higher cost of sourcing the material product that is certified to be free of forced labor.

If you are a contractor, builder, or subcontractor, and you have evidence of forced labor in the material supply chain of a material.

4. You can alert the designer and client/owner of forced labor in the supply chain of a specified product.

5. You can reject a material product that is supplied by a subcontractor or supplier that you suspect or that you know was manufactured using forced labor.

6.6 PROJECT CONCLUSIONS

Three key conclusions can be drawn from this research project:

1. **The industry lacks transparency in what concerns the material supply chains of all building products used to construct the built environment.**
    a. Manufacturers are unaware of the forced labor risks in their supply chains. In a culture of capital flows predicated on "don't ask, don't tell":
        i. Company representatives who serve designers are unaware of the problem of forced labor and of what their companies are doing in this regard.
        ii. Company representatives are minimally more aware of their company's sustainability position, but without access to hard evidence to prove their claims.
        iii. Company representatives were ineffective at connecting us with company representatives who might know more about material supply chains.
    a. Designers are mostly unaware of the extent and scale of forced labor in the material supply chains of the products they specify.
    b. Researchers affiliated with the building industry are insufficiently focused on the supply chain of materials used in constructing the built environment. The lack of academic activity amongst landscape architects and architects in this space is clear evidence of the fact that few question the origin of materials with which we build.

2. **Industry-based Certifications are presently insufficiently robust to ensure that forced labor is not found in the supply chain of our material products.**

    a. None of the certifications we reviewed certifies products in the construction industry against the presence of forced labor.

3. **Greater transparency in material supply chains is required, with access to third-party, objective data essential for investigating and evaluating the forced labor risk of any one company in the building industry.**

    Corporate advertising and marketing are insufficient and, at times, misleading indicators of a company's forced labor risk.
    a. Using the SAYARI Graph interface, we produced an Evaluated Risk Assessment Scale for assessing the forced labor risk of 34 companies.
    b. Summary of the Evaluated Risk Assessments for all 34 companies. (One company includes two subsidiaries bringing the sum below to 36.)
        - 10 companies had Clear Evidence of Forced Labor Risk
        - 8 companies had First Tier Forced Labor Risk*
        - 5 companies had Second Tier Forced Labor Risk
        - 2 companies had Third Tier Forced Labor Risk
        - 1 company had Possibly No Forced Labor Risk
        - 0 companies had No Forced Labor Risk
        - 10 companies had Insufficient Information in Sayari to Evaluate

        *Tiers are moments in the supply chain where a company transfers a material component to another

6.7 PROJECT RECOMMENDATIONS

The following outlines the most basic tenets of a culture of informed practice dedicated to minimizing, if not eliminating, the risk of forced labor in the supply chain of landscape architecture products.

1. Laws exist – use them!
International, national, state-, and city-wide laws exist in support of workers, their rights, livelihood, and health. This report identifies and discusses several laws that are effective for reducing the incidence of imported material products made with forced labor. Notwithstanding the difficulty in enforcing these laws, knowing that they exist, and communicating that they do to clients, public officials, contractors, and materials representatives is a clear path to more informed decision-making.

2. Lobby to be heard, act to instill real change.
The scale of the problem cannot be denied. Is this because few design professionals speak to the incidence of forced labor with their colleagues, clients, public officials, and material suppliers? Should we more actively share this information as widely and repeatedly as possible? Should design students be taught about the toil of those who labor on their behalf when building their designs? Should material manufacturers and everyone who supplies raw materials be held to greater levels of transparency in disclosing how their products are manufactured? Should they be required to communicate which materials they've used, where they originate from, and if and how they imperil others at any point in their supply chain? Should we be ethically held to sharing with the public questionable corporate practices that transgress human-centered values, including the use of forced labor? Should we lobby for greater legislative leverage to ensure that no building or landscape project renders someone precarious? YES!

3. Align project teams to the values of forced labor-free supply chains
Every new project is another opportunity to expand the network of professionals and clients committed to ensuring that forced labor is not present in the building industry. Speak openly and committedly about aligning all stakeholders to this shared mission. Articulate clear goals that are measurable, verifiable, and communicable. Ensure benchmarks, contract documents, and specifications establish the goals, mechanisms, penalties, and redress for ensuring that all who are signatories to the contract are held responsible for ensuring that no forced labor is identifiable in the supply chain of all materials and services associated with the project.

4. Identify which raw materials are at most risk of forced labor.
Every raw material in the building industry is at risk of being produced using forced labor, including the most pedestrian of materials that many do not recognize as a building material —sand, and the most chemically synthesized that begins its life in a lab—polyethylene. Using the sources offered in this report, identify which are the most critical for your landscape design project. Assess the ratio of the risk and ask for modifications and changes as required.

5. Identify supply chains of material products and their companies at most risk of forced labor.
Large sectors of the global supply chain of building material products are at risk of being produced using forced labor, including the most typically specified—concrete, and the most rarefied—rubber gaskets for double skin facades. Given the material complexity of most high-performing products that are engineered for specialized activities, and the composite nature of many of our materials, following the supply chain of most building products is a highly complex endeavor. In every project you work on, identify (5) material products you believe are at high risk, and (5) material products that comprise the greatest part of the project budget. Focus on their overlap and ensure the team has the correct investigative mechanisms to identify whether the material products specified for your project are at risk for forced labor.

6. Require proven fair labor certifications and associated language in contract specifications.
Encourage certifications that are rigorous, data based, and whose evidence is verifiable. Encourage language in contract documents focused on forced labor, including penalties should materials be found with forced labor, including the right of refusal and of payment for said material. Designers should directly engage their suppliers on questions of supply chains and their fair labor certifications to increase demand for the resources of help to manufacturers who wish to obtain fair labor certifications. When including the requirement for fair labor certifications in specifications, it is important to have an agreement in place from as early in the project design and documentation phases as possible.

7. Investigate and ask questions.

Much of the information you seek is not immediately available. This became clearly apparent to us during this research project. The building industry lacks transparency in its material supply chains for most products used to construct the built environment, partly due to a lack of interest, corporate competition, and patenting of products. Both company representatives and designers are largely unaware of the extent of the problem and how best to secure accurate data for decision-making. Corporate-issued advertising and marketing are insufficient forms of information gathering. Sustainability statements are often too general to be verifiable, ESG claims are not metrically certifiable, and EPDs and HPDs are nonexistent. Moreover, it is not surprising that many claims made by for-profit enterprises are at times misleading.

What is needed is access to third-party, objective data for investigating and evaluating the forced labor risk of any one company in the building industry. And this, because the typical business protocols available to designers rarely reveal the required information to investigate what is in a product, how it is sourced, and whether it was produced in questionable human circumstances. In fact, much in the day-to-day business of construction (landscape and building) is designed to obfuscate precisely the information we seek on corporate governance. Investigative tactics are a prerequisite for entering into less-than-transparent territories where harms against laborers proliferate. Look deeply, ask many questions!

Endnotes

[1] Trade Facilitation and Trade Enforcement Act of 2015 https://www.congress.gov/bill/114th-congress/house-bill/644

[2] The Uyghur Forced Labor Prevention Act, or UFLPA was signed into law as the U.S. response to the Chinese government's systemic use of forced labor against Uyghurs and other ethnic minorities in the Xinjiang Uyghur Autonomous Region (XUAR) in the Peoples's Republic of China. UShttps://www.cbp.gov/trade/forced-labor/UFLPA

[3]https://www.cbp.gov/newsroom/stats/trade/uyghur-forced-labor-prevention-act-statistics

[4] Business and Human Rights Resource Centre, "2022 KnowTheChain ICT Benchmark,"https://www.business-humanrights.org/en/from-us/briefings/2022-knowthechain-ict-benchmark/

[5] Know the Chain, Apparel and footwear, https://www.business-humanrights.org/en/from-us/knowthechain/apparel-and-footwear-benchmark/

[6] Know the Chain, Food and beverage, https://www.business-humanrights.org/en/from-us/knowthechain/food-and-beverage-benchmark/

[7] Know the Chain, information and communications technology, https://www.business-humanrights.org/en/from-us/knowthechain/information-and-communications-technology/

This page is intentionally left blank

7.0 Bibliography

7.0 | BIBLIOGRAPHY

SECTION ORGANIZATION:

FORCED LABOR
- Modern Slavery, General
  - Academic Sources - Books, Articles, Conference Proceedings
  - Ngos And Civil Society (Policies, Laws, Advocates)
- Landscape Architecture, Design Theory, And Forced Labor
- Building Industry And Forced Labor

MATERIALS
- General Sources on Materials
- Project Materials
  - Permeable Pavers
  - Geotextiles
  - Synthetic Turf
  - Safety Surface
  - Recycled Plastic Lumber
- Industry Announcements
- Advertising – Marketing Issued by the Company
- Epd/ Sustainability Statements/ Data Sheets Collected
- In The News
- Company Statements

SUPPLY CHAIN MAPPING
- Supply Chains and Trade Data
- Supply Chain Mapping in Architecture and the Building Industry
- Supply Chain Compliance
  - Import Genius
  - Sayari.com
- Graphic Communication

* This Bibliography may not include all the sources included in the Endnotes.

FORCED LABOR

Modern Slavery, General

Academic Sources

Alzoubi, Yazan, Giorgio Locatelli, and Tristano Sainati. "Modern Slavery in Projects: A Systematic Literature Review and Research Agenda." *Project Management Journal* 54, no. 3 (2023): 235–252. https://doi.org/10.1177/87569728221148158.

Benstead, Amy V., Linda C. Hendry, and Mark Stevenson. "Detecting and Remediating Modern Slavery in Supply Chains: A Targeted Audit Approach." *Production Planning & Control* 32, no. 13 (2021): 1136–1157. https://doi.org/10.1080/09537287.2020.1795290.

Brickell K., Parsons L., Natarajan, N., & Chann, S. 2018. *Blood Bricks: Untold Stories of Modern Slavery and Climate Change from Cambodia*. Royal Holloway University of London.

Caruana, Rory, Andrew Crane, Stefan Gold, and Genevieve LeBaron. 2021. "Modern Slavery in Business: The Sad and Sorry State of a Non-Field." *Business & Society* 60, no. 2: 251–87.

Crane, Andrew, Genevieve LeBaron, Jean Allain, and Laya Behbahani. 2019. "Governance Gaps in Eradicating Forced Labor: From Global to Domestic Supply Chains." *Regulation & Governance* 13, no. 1: 86–106.

Ford, Jolyon, and Justine Nolan. "Regulating Transparency on Human Rights and Modern Slavery in Corporate Supply Chains: The Discrepancy between Human Rights Due Diligence and the Social Audit." *Australian Journal of Human Rights* 26, no. 1 (2020): 27–45. https://doi.org/10.1080/1323238X.2020.1761633.

Friedman, Vanessa. “How Can I Be Sure My Clothes Aren’t Being Made in a Sweatshop?” *The New York Times*, July 28, 2025. https://www.nytimes.com/2025/07/28/fashion/sweatshop-ethical-clothes.html.

Ghani, Faras. “Labour Law Changes: Are Qatar’s Migrant Workers Better Off?” *Al Jazeera*, March 15, 2021. https://www.aljazeera.com/features/2021/3/15/labour-law-changes-are-qatars-migrant-workers-better-off.

Grandin, Greg, *Fordlandia, The Rise and Fall of Henry Ford’s Forgotten Jungle City* (Picador, 2009)

Gutierrez-Huerter O, Gabriela, Stefan Gold, and Alexander Trautrims. "Change in Rhetoric but Not in Action? Framing of the Ethical Issue of Modern Slavery in a UK Sector at High Risk of Labor Exploitation." *Journal of Business Ethics*, (2023): 35-58. https://doi.org/10.1007/s10551-021-05013-w.

Han, Chen, Fu Jia, Mengqi Jiang, and Lujie Chen. "Modern Slavery in Supply Chains: A Systematic Literature Review." *International Journal of Logistics Research and Applications*, published September 5, 2022. https://doi.org/10.1080/13675567.2022.2118696.

Jackson, Joe, *The Thief at the End of the World, Rubber, Power, and the Seeds of Empire* (Penguin Books, 2008)

Kara, Siddharth, *Cobalt Red*, *How the Blood of the Congo Powers our Lives* (St. Martin’s Griffin, 2023)

Karen Human Rights Group. *Surviving in Shadow: Widespread Militarization and the Systematic Use of Forced Labour in the Campaign for Control of Thaton District*. January 17, 2006; http://khrg.org/2006/01/khrg0601j/surviving-shadow-widespread-militarization-and-systematic-use-forced-labour

Kelley, Annie. “The UK's new slavery laws explained: what do they mean for business?” *The Guardian*, December 14, 2015.

LeBaron, Genevieve. “The Global Business of Forced Labour: Report of Findings.” Sheffield, UK: University of Sheffield, 2018. http://globalbusinessofforcedlabour.ac.uk/wp-content/uploads/2018/05/Report-of-Findings-Global-Business-of-Forced-Labour.pdf.

Locatelli, Giorgio, Eleni Konstantinou, Joana Geraldi, and Tristano Sainati. 2022. “The Dark Side of Projects: Uncovering Slavery, Corruption, Criminal Organizations, and Other Uncomfortable Topics.” *Project Management Journal* 53, no. 4: 327–30.

Louie, Leslie, Brandon Cuffy, Ryan Welch, and Billie Faircloth. "How Alternative Governance Models Can Help the Design Community Combat Forced Labor." *Design for Partnerships for Change*, edited by Leslie Louie et al., 353-362. Springer International Publishing, 2023. https://doi.org/10.1007/978-3-031-36993-3_28.

MacLean, Ken. “Capitalizing on Conflict: How Logging and Mining Contribute to Environmental Destruction in Burma.” October 2003; https://www.earthrights.org/publication/capitalizing-conflict-how-logging-and-mining-contribute-environmental-destruction-burma.

Mitman, Gregg, *Empire of Rubber, Firestone’s Scramble for Land and Power in Liberia* (The New Press, 2021)

Natarajan, Nithya, Katherine Brickell, and Lauren Parsons. 2021. “Diffuse Drivers of Modern Slavery: From Microfinance to Unfree Labour in Cambodia.” *Development and Change* 52, no. 2: 241–64.

Nolan, Justine, and Gregory Bott. 2018. “Global Supply Chains and Human Rights: Spotlight on Forced Labour and Modern Slavery Practices.” *Australian Journal of Human Rights* 24, no. 1: 44–69.

Parsons, Laurie, *Carbon Colonialism, How rich countries export climate breakdown* (Manchester University Press, 2023)

Quirk, Joel, *The Anti-Slavery Project from the Slave Trade to Human Trafficking. Philadelphia: University of Pennsylvania Press*, 2011.

Rak, Przemyslaw. “Modern Day Slavery: The Kafala System in Lebanon.” *Harvard International Review*, 2020. https://hir.harvard.edu/modern-day-slavery-the-kafala-system-in-lebanon/.

Rioux, Sébastien, Genevieve LeBaron, and Peter J. Verovšek. "Capitalism and Unfree Labor: A Review of Marxist Perspectives on Modern Slavery." *Review of International Political Economy* 27, no. 3 (2020): 709–731. https://doi.org/10.1080/09692290.2019.1650094.

Rohter, L. “Brazil’s Prized Exports Rely on Slaves and Scorched Land.” *The New York Times*, March 25, 2002; http://query.nytimes.com/gst/fullpage.html?res=9C04E7DE153BF936A15750C0A9649C8B63.

Skinner, E. Benjamin, *A Crime so Monstrous, Face-to-Face with Modern Slavery* (Simon & Shuster, 2008)

Sönmez, Sevil, Yorghos Apostolopoulos, and David Tran. 2011. “Human Rights and Health Disparities for Migrant Workers in the UAE.” *Health and Human Rights,* 13, no. 2: 19

Timmons, Heather, and J. Adam Huggins. “New York Manhole Covers, Forged Barefoot in India.” *The New York Times*, November 26, 2007. https://www.nytimes.com/2007/11/26/nyregion/26manhole.html.

NGOs and Civil society (policies, laws, advocates)

Amnesty International. “The Ugly Side of the Beautiful Game: Exploitation of Migrant Workers on a Qatar 2022 World Cup Site.” *London: Amnesty International, 2016*. https://www.amnesty.org/en/documents/mde22/3548/2016/en/.

Anti-Slavery International. “What Is Modern Slavery?” *Anti-Slavery International*, 2021. https://www.antislavery.org/.

Anti-Slavery International. “Protecting Migrant Workers in the Gulf.” *Anti-Slavery International Reporter*, Autumn 2024, 10–11.

Anti-Slavery International. “Campaigning for Justice in Qatar.” *Anti-Slavery International Reporter*, Spring 2023, 8.

Abrahams, Désirée, *Guide to Human Rights Impact Assessment and Management (HRIAM)*, International Business Leaders Forum, 2010

Business for Social Responsibility. *Conducting an Effective Human Rights Impact Assessment: Guidelines, Steps, and Examples*. March 1, 2013. https://www.bsr.org/reports/BSR_Human_Rights_Impact_Assessments.pdf

Crawford, A. & Murphy, Laura. 2023. “OVEREXPOSED: Uyghur Region Exposure Assessment for Solar Industry Sourcing.” *Sheffield Hallam University Helena Kennedy Center for International Justice.*

Design for Freedom, https://www.designforfreedom.org

- Pilot Project Case Study - New Canaan Library by Centerbrook Architects + Planners, MillerKnoll, and Turner Construction Company, New Canaan, CT; https://www.designforfreedom.org/wp-content/uploads/2024/03/DFF-New-Canaan-Library-Case-Study.pdf
- Grace Farms Foundation. *Design for Freedom International Guidance and Toolkit*. Grace Farms, 2023. https://www.designforfreedom.org/home/design-for-freedom-international-guidance-toolkit/
- Grace Farms Foundation. *Design for Freedom Toolkit*. Grace Farms, 2023. https://www.designforfreedom.org/wp-content/uploads/2023/12/DFF-Toolkit-Download.pdf
  - Grace Farms Foundation. Design for Freedom Material Tracking Schedule.
  - Grace Farms Foundation. Design for Freedom: Sample Specification - Ethical Design Requirements.
  - Grace Farms Foundation. Design for Freedom Supplier Outreach Letter.
  - Grace Farms Foundation. Design for Freedom Supplier Questionnaire.
- Prince, Sharon, Luis C. de Baca, and Chelsea Thatcher, eds. *Design for Freedom: A Call to Action to Eliminate Forced Labor in the Building Materials Supply Chain*. Grace Farms Foundation, 2022. https://www.designforfreedom.org.

Gangmasters & Labour Abuse Authority (GLAA). "Labour Exploitation: Spot the Signs." *London: GLAA*, 2020. https://www.gla.gov.uk/i-am-a/i-use-workers/construction-protocol/.

Global Slavery Index (GSI). "Modern Slavery: A Hidden, Every Day Problem." *London: Global Slavery Index*, 2018. https://www.globalslaveryindex.org/.

Hall, Lauren "Modern Day Slavery—The Kafala System." *The Organization for World Peace (OWP)*, 2018. https://theowp.org/reports/modern-day-slavery-the-kafala-system/.

Human Rights Watch. 2012. *Building a Better World Cup: Protecting Migrant Workers in Qatar Ahead of Fifa 2022*. June 12. https://www.hrw.org/report/2012/06/12/building-better-world-cup/protecting-migrant-workersqatar-ahead-fifa-2022.

Human Rights Watch. 2006. *Building Towers, Cheating Workers: Exploitation of Migrant Construction Workers in the United Arab Emirates.* November 11. https://www.hrw.org/report/2006/11/11/building-towers-cheatingworkers/exploitation-migrant-construction-workers-united.

Human Rights Watch. 2017. *Qatar: Take Urgent Action to Protect Construction Workers, FIFA, National Associations Should Press Qatar on Hear Risks, Preventable Deaths.* September 27. https://www.hrw.org/news/2017/09/27/qatar-take-urgent-action-protect-construction-workers.

International Labour Organization (ILO). "Child Labour: Global Estimates 2024, Trends and the Road Forward." 2024. https://www.ilo.org/publications/major-publications/child-labour-global-estimates-2024-trends-and-road-forward.

International Labour Organization (ILO). "Acting Against Forced Labour: An Assessment of Investment Requirements and Economic Benefits." 2024. https://www.ilo.org/publications/major-publications/acting-against-forced-labour-assessment-investment-requirements-and.

International Labour Organization (ILO). "Profits and Poverty: The Economics of Forced Labour." 2024. https://www.ilo.org/publications/major-publications/profits-and-poverty-economics-forced-labour.

International Labour Organization (ILO). "Global Estimates of Modern Slavery: Forced Labour and Forced Marriage." 2017. https://www.ilo.org/global/publications/books/WCMS_575479/lang--en/index.htm.

International Labour Organization (ILO). "What Is Forced Labour, Modern Slavery and Human Trafficking." 1930. https://www.ilo.org/topics/forced-labour-modern-slavery-and-trafficking-persons/what-forced-labour.

KPMG. "Property, Construction & Modern Slavery: Practical Responses for Managing Risk to People." Australian Human Rights Commission, 2020. https://assets.kpmg/content/dam/kpmg/au/pdf/2020/property-construction-modern-slavery-practical-guide.pdf.

Murphy, L & Elimä, N. 2021. "In Broad Daylight, Uyghur Forced Labour and Global Solar Supply Chains." *Sheffield Hallam University Helena Kennedy Centre for International Justice.*

Murphy, L. & Vallette, J. & Elimä, N. 2022. "Built on Repression: PVC Building Materials' Reliance on Labor and Environmental Abuses in the Uyghur Region." *Sheffield Hallam University Helena Kennedy Center for International Justice:* 11-18.

"Policy Brief No. 2: Reform of the Kafala Sponsorship System." *Migrant Forum in Asia*. 2012. https://mfasia.org/policy-brief-no-2-reform-of-the-kafala-sponsorship-system/.

Stronger Together. 2020. "Tackling Modern Slavery, A Toolkit for Organizations in the UK Construction and Property."

UN_ International Business Leaders Forum, International Finance Corporation, and United Nations Global Compact. *Rights Impact Assessment and Management*. 2010. https://unglobalcompact.org/library/25.

United Nations. "Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, Supplementing the United Nations Convention Against Transnational Organized Crime." *New York: United Nations*, 2000. https://www.ohchr.org/en/instruments-mechanisms/instruments/protocol-prevent-suppress-and-punish-trafficking-persons.

U.S. Department of Labor. "Wages and the Fair Labor Standards Act." Last modified October 4, 2025. https://www.dol.gov/agencies/whd/flsa.

US Government
U.S. Department of Labor. *2022 List of Goods Produced by Child Labor or Forced Labor*. Washington, DC: U.S. Department of Labor, 2022. https://www.dol.gov/sites/dolgov/files/ILAB/child_labor_reports/tda2021/2022-TVPRA-List-of-Goods-v3.pdf

Zayadin, Hala. "Migrant Workers and the Qatar World Cup." *Jadaliyya Magazine. Human Rights Watch*, August 2, 2021. https://www.hrw.org/news/2021/08/02/migrant-workers-and-qatar-world-cup.

Landscape Architecture, Design Theory, and Forced Labor

Franco, Michelle Arevalos. "Care's Repair, Landscape's Labor." *Landscape Research* 49, no. 4 (2024): 584–594. https://doi.org/10.1080/01426397.2023.2270492.

Franco, Michelle Arevalos. "Invisible Labor: Precarity, Ethnic Division, and Transformative Representation in Landscape Architecture Work." *Landscape Journal* 41, no. 1 (2022): 95–111.https://doi.org/10.3368/lj.41.1.95:contentReference[oaicite:0]{index=0.

Grigo, Kamila. "Breaking Bonds." *Landscape Architecture Magazine*, December 15, 2022. https://landscapearchitecturemagazine.org/?s=breaking+bonds&orderby=relevance&order=DESC&post_type=post. (the Serpentine Gallery and Grace Farms)

Hac, Caroline, "Material Milestones." Landscape Architecture Magazine, April 2024, 38. Gale General OneFile. Accessed July 22, 2024. https://link.gale.com/apps/doc/A788240942/ITOF?u=upenn_main&sid=summon&xid=3fe76488.

McCormick, Katherine Hope. "Co-Creating the Yard: A Study in Defining Dignity in the Workplace for Landscape Labor." Master's thesis, University of Maryland, 2024. https://doi.org/10.13016/vn0t-fze6.

Reut, Jennifer, "Object Lessons." *Landscape Architecture Magazine*, December 2022, 14. Gale General OneFile, https://link-gale-com.proxy.library.upenn.edu/apps/doc/A736792010/ITOF?u=upenn_main&sid=summon&xid=ea6eb6cb

Ockman, Joan. "Toward a Political Ecology of Architecture." *Places Journal*, March 2022. Accessed October 19, 2024. https://placesjournal.org/article/toward-a-political-ecology-of-architecture/.

Sturlaugson, Brent. "What You Don't See Matters: Supply Chain Capitalism and the Architecture of Production." *In Crossings Between the Proximate and Remote: Fall Conference Proceedings*, edited by Urs Peter Flueckiger and Victoria McReynolds. 2018.

American Collegiate Schools of Architecture. Accessed October 24, 2024. https://www.acsa-arch.org/chapter/what-you-dont-see-matterssupply-chain-capitalism-and-the-architecture-of-production/.

This was originally published as " What You Don't See" in Places https://placesjournal.org/article/the-supply-chain-of-architecture/?cn-reloaded=1

Building Industry and Forced Labor

Beaumont, John Russell, *Survey of Labor Certifications for the Built Environment*, (2022), COOKFOX Architects. https://cookfox.com/wp-content/uploads/2022/04/COOKFOX_Survery-of-Labor-Certifications-for-the-Built-Environment_2022.pdf

Patricia Bray, "Heat-Related Illnesses: Opportunities for Prevention," *Journal of Occupational Medicine Forum (JOEM)*, Vol. 52, n. 8 (August 2010) : 844-845

CIOB, The Chartered Institute of Building. 2016. "Building a Fairer System, Tackling Modern Slavery in Construction Supply Chains." https://d8.ciob.org/industry/research/Building-Fairer-System-Tacklingmodern-slavery-construction-supply-chains

CIOB, The Chartered Institute of Building. 2018. "Construction and the Modern Slavery Act, Tackling Exploitation in the UK". https://www.ciob.org/industry/research/State-of-Well-being-Construction-Industry

Cockbain, Ella, and Helen Brayley-Morris. "Human Trafficking and Labour Exploitation in the Casual Construction Industry: An Analysis of Three Major Investigations in the UK Involving Irish Traveller Offending Groups." P*olicing: A Journal of Policy and Practice* 12, no. 2 (2018): 129–149. https://doi.org/10.1093/police/pax037.

Crates, Emma. "Building a Fairer System: Tackling Modern Slavery in Construction Supply Chains." B*racknell, UK: Chartered Institute of Building (CIOB)*, 2016. https://www.ciob.org/industry/research/Building-Fairer-System-Tackling-modern-slavery-construction-supply-chains.

Crates, Emma. "Construction and the Modern Slavery Act: Tackling Exploitation in the UK." *Bracknell, UK: Chartered Institute of Building (CIOB)*, 2018. https://www.ciob.org/industry/research/State-of-Well-being-Construction-Industry.

Dharmapalan, V., W. J. O'Brien, and D. J. Morrice. 2021. "Defining Supply Chain Visibility for Industrial Construction Projects." *Frontiers in Built Environment,* 7: 651294. https://doi.org/10.3389/fbuil.2021.651294.

Dodd, Tracey, James Guthrie, and John Dumay. "Management Controls and Modern Slavery Risks in the Building and Construction Industry: Lessons from an Australian Social Housing Provider." *Business Accountability*, 35 (2022) https://doi.org/10.1016/j.bar.2022.101098.

Dong, Xiuwen Sue et al., "Heat- related deaths among construction workers in the United States," *American Journal of Industrial Medicine*, vol.1., n.11., June 2019 DOI: 10.1002/ajim.23024

Elk, Mike. "'They Treat Us like Mules': Nashville Construction Workers Cry for Site Safety." *The Guardian. Guardian News and Media*, September 17, 2018. https://www.theguardian.com/us-news/2018/sep/17/nashville-construction-workers#img-1.

Holpuch, Amanda. "Undocumenteds Fade from the City They Helped Build." *The Guardian. Guardian News and Media*, March 17, 2017. https://www.theguardian.com/cities/2017/mar/17/undocumented-immigrants-charlotte-north-carolina-construction.

Jones, Peter, and Daphne Comfort. "Modern Slavery Statements and the UK's Largest Housebuilding Companies: An Exploratory Research Paper." *Property Management,* 40, no. 5 (2022): 658-670. https://doi.org/10.1108/PM-06-2021-0043.

Johnson, Mark L. "Undocumented Workers: Immigrants on Hold." *Association of the Wall and Ceiling Industry*. May 2015.

Larmar, Stephen, Patrick O'Leary, Chi Chui, Karen Benfer, Sebastian Zug, and Lucy P. Jordan. "Hazardous Child Labor in Nepal: The Case of Brick Kilns." *Child Abuse & Neglect,* 72 (2017): 312–325. https://doi.org/10.1016/j.chiabu.2017.08.008.

Liu, Tingting, Evgeny Suprun, Rodney A. Stewart, and Silvia Duran. "Developing a Framework for Assessing the Readiness of Entities in the Construction Industry in Addressing Modern Slavery." *Sustainable Production and Consumption,* 31 (2022): 139–151. https://doi.org/10.1016/j.spc.2022.02.018.

Millward, Peter. "World Cup 2022 and Qatar's Construction Projects: Relational Power in Networks and Relational Responsibilities to Migrant Workers." *Current Sociology,* 65, no. 5 (2017): 756–776. https://doi.org/10.1177/0011392116645382.

Morris, Athina. "Construction Worker Dies after Being Trapped under Road Roller in Tampa." WFLA. *News Channel 8*, September 15, 2018. https://www.wfla.com/news/hillsborough-county/construction-worker-dies-after-being-trapped-under-road-roller-in-tampa/1448473135.

Pesterfield, Christopher, and Michael Rogerson. "Institutional Logics in the UK Construction Industry's Response to Modern Slavery Risk: Complementarity and Conflict." *Journal of Business Ethics*, published 2023. https://doi.org/10.1007/s10551-023-05455-4.

Segerstedt, Anders, and Thomas Olofsson. "Supply Chains in the Construction Industry." *Supply Chain Management: An International Journal,* 15, no. 5 (2010): 347-353. https://doi.org/10.1108/13598541011068260.

Sokas, Rosemary K. and Emily Senay. "Preventing Heat-Related Illness among Outdoor Workers — Opportunities for Clinicians and Policymakers," *The New England Journal of Medicine*, October 5, 2023.

Suprun, E., R. Almeshari, T. Liu, R.A. Stewart, and S. Duran. "Beyond Compliance in the Construction Sector: Mapping the Modern Slavery Statements Through Content Analysis." *IOP Conference Series: Earth and Environmental Science,* 1101, no. 3 (2022): 032018. https://doi.org/10.1088/1755-1315/1101/3/032018.

Trautrims, Alexander, Stefan Gold, Anne Touboulic, Caroline Emberson, and Helen Carter. "The UK Construction and Facilities Management Sector's Response to the Modern Slavery Act: An Intra-Industry Initiative against Modern Slavery." *Business Strategy and Development,* 4, no. 3 (2021): 279–293. https://doi.org/10.1002/bsd2.158.

MATERIALS

General Sources on Materials

Bergman, Richard D., Hongmei Gu, Robert H. Falk, and Thomas R. Napier. "Using Reclaimed Lumber and Wood Flooring in Construction: Measuring Environmental Impact Using Life-Cycle Inventory Analysis." In *Proceedings of the International Convention of Society of Wood Science and Technology and United Nations Economic Commission for Europe – Timber Committee*, October 11-14, 2010, Geneva, Switzerland.

Fenichell, Stephen, *Plastic, The Making of a Synthetic Century* (Harper Business, 1996)

Thompson, Rob. *Manufacturing Processes for Design Professionals*. London: Thames & Hudson, 2007

Materiology, the Creative Industry's Guide to Materials and Technologies (Birkhauser, FRAME, 2009)

Project Materials

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component of this report)

Permeable Pavers - In the News

"AG Van Hollen: Wausau Company Settles State Environmental Lawsuit for $250,000." WisBusiness.com, April 14, 2011. https://www.wisbusiness.com/2011/ag-van-hollen-wausau-company-settles-state-environmental-lawsuit-for-250000/.

Cruz v. Unilock Chicago, Inc., Docket No. 2-07-1031, Illinois Appellate Court, Second District, June 25, 2008. https://cases.justia.com/illinois/court-of-appeals-second-appellate-district/2071031.pdf?ts=1462337285.

EP Henry Corporation v. Cambridge Pavers, Inc., Civil Action No. 1:2017cv01538, United States District Court for the District of New Jersey, December 9, 2019. https://cases.justia.com/federal/district-courts/new-jersey/njdce/1:2017cv01538/345683/89/0.pdf?ts=1576059695."

Hanover Prest-Paving Co. v. Staten Island Building Products Dist. Inc., Civil Action No. 1:21-CV-01672, United States District Court for the Middle District of Pennsylvania, June 9, 2025. https://www.govinfo.gov/content/pkg/USCOURTS-pamd-1_21-cv-01672/pdf/USCOURTS-pamd-1_21-cv-01672-1.pdf.

"Overview of Unilock Class Action Overtime Lawsuit and Settlement." *Law Offices of Colleen M. McLaughlin*. https://www.cmmclaw.com/overview-of-unilock-class-action/.

Subramanian, Samanth. "The Cement Company That Paid Millions to Isis: Was Lafarge Complicit in Crimes Against Humanity?" *The Guardian,* September 17, 2024. https://www.theguardian.com/world/2024/sep/17/french-cement-company-lafarge-paid-millions-to-islamic-state-syria.

"Wausau Tile, Inc. v. County Concrete Corporation," Docket No. 97-2284, Wisconsin Supreme Court, May 28, 1999. https://cases.justia.com/wisconsin/supreme-court/1997AP002284-(1999-05-28).pdf.

Geotextile – In the News

Baily, Mary. "Sika and Sulzer to Establish Plastics Recycling JV." *Chemical Engineering*, June 3, 2025. https://www.chemengonline.com/sika-and-sulzer-to-establish-plastics-recycling-jv/?printmode=1.

"Sika Acquires Renowned Construction Chemicals Company in Qatar." *Yahoo Finance*, June 26, 2025. https://uk.finance.yahoo.com/news/sika-acquires-renowned-construction-chemicals-050000842.html.

Synthetic Turf

Breland, R. D. "Performance Standards for Artificial Turf." *ASTM Special Technical Publication,* 1073 (1990): 81–93. https://doi.org/10.1520/STP25361S.

Graça, Cátia A. L., Filipe Rocha, Filipa O. Gomes, M. Rosário Rocha, Vera Homem, Arminda Alves, and Nuno Ratola. "Corrigendum to 'Presence of Metals and Metalloids in Crumb Rubber Used as Infill of Worldwide Synthetic Turf Pitches: Exposure and Risk Assessment' [*Chemosphere,* 299 (July 2022) 134379]." *Chemosphere* 307 (2022) https://doi.org/10.1016/j.chemosphere.2022.135446.

Perkins, Alaina N., Salmaan H. Inayat-Hussain, Nicole C. Deziel, Caroline H. Johnson, Stephen S. Ferguson, Rolando Garcia-Milian, David C. Thompson, and Vasilis Vasiliou. "Evaluation of Potential Carcinogenicity of Organic Chemicals in Synthetic Turf T Crumb Rubber." *Environmental Research* 169 (2019): 163–172. https://doi.org/10.1016/j.envres.2018.10.018.

Peterson, Michael K., Julie C. Lemay, Sara Pacheco Shubin, and Robyn L. Prueitt. "Comprehensive Multipathway Risk Assessment of Chemicals Associated with Recycled ('Crumb') Rubber in Synthetic Turf Fields." *Environmental Research* 160 (2018): 256–268. https://doi.org/10.1016/j.envres.2017.09.019.

Schneider, Klaus, Manfred de Hoogd, Maria Pelle Madsen, Pascal Haxaire, Anne Bierwisch, and Eva Kaiser. "ERASSTRI - European Risk Assessment Study on Synthetic Turf Rubber Infill – Part 1: Analysis of Infill Samples." *Science of The Total Environment,* 740 (2020) https://doi.org/10.1016/j.scitotenv.2020.137174.

Schneider, Klaus, Manfred de Hoog, Pascal Haxaire, Arne Philipps, Anne Bierwisch, and Eva Kaiser. "ERASSTRI - European Risk Assessment Study on Synthetic Turf Rubber Infill – Part 2: Migration and Monitoring Studies." *Science of The Total Environment* 740 (2020) https://doi.org/10.1016/j.scitotenv.2020.137173.

Schneider, Klaus, Anne Bierwisch, and Eva Kaiser. "ERASSTRI - European Risk Assessment Study on Synthetic Turf Rubber Infill – Part 3: Exposure and Risk Characterisation." *Science of The Total Environment,* 748 (2020) https://doi.org/10.1016/j.scitotenv.2020.137721.

Synthetic Turf – In the News

"Amid a Battle over Turf Plans for FDR Park, Experts Say Claims of PFAS-Free Fake Grass Are Misleading." *The Philadelphia Inquirer*, July 25,

2024. https://www.inquirer.com/news/philadelphia-artifical-turf-fdr-park-pfas-project2025-epa-20240725.html#loaded.

"Artificial Turf Company Hit with Big SLAPP Suit." *Public Employees for Environmental Responsibility (PEER)*, June 18, 2025. https://peer.org/artificial-turf-company-hit-with-big-slapp-suit/.

"Artificial Turf Companies Take Action on Forever Chemicals." *KRON4*, January 23, 2024. https://www.kron4.com/business/press-releases/ein-presswire/682464521/artificial-turf-companies-take-action-on-forever-chemicals/#:~:text=PFAS%20are%20found%20in%20everyday,its%20sports%20turf%20field%20products.%E2%80%9D.

"Brown Reaches Settlement to Reduce Children's Lead Exposure in Artificial Turf." C*alifornia Department of Justice – Office of the Attorney General*, July 16, 2010. https://oag.ca.gov/news/press-releases/brown-reaches-settlement

Center for Environmental Health. *60-Day Notice 2008-00204*. California Department of Justice, May 15, 2008. https://oag.ca.gov/system/files/prop65/notices/2008-00204.pdf

Center for Environmental Health. *60-Day Notice 2012-00173*. California Department of Justice, March 9, 2012. https://oag.ca.gov/system/files/prop65/notices/2012-00173.pdf

Christopher, Thomas, Ranter Emeritus. "Synthetic Turf Is Even Worse Than Real Lawn." *GardenRant*, August 5, 2019. https://gardenrant.com/2019/08/real-vs-synthetic-turf.html.

Congaree Riverkeeper v. Shaw Industries Group, Inc., Civ. No. 3:24-cv-03810-SAL, Complaint for Declaratory and Injunctive Relief, filed July 2, 2024. https://irp.cdn-website.com/faba37e6/files/uploaded/Filed_Shaw_Compl

"Federal Judge Grants Settlement Approval in FieldTurf USA Lawsuit That Included NJ Schools." *NJ.com*, December 15, 2024. https://www.nj.com/middlesex/2024/12/federal-judge-grants-settlement

"FieldTurf Files Complaint Against Sprinturf." *Floor Daily*, September 19, 2006. https://www.floordaily.net/flooring-news/fieldturf-files-complaint-against-sprinturf.

Freedman, Robert. "Polyloom Accused of Stopping Grassroots Webinar on Turf Health Impacts." *Facilities Dive*, June 30, 2025. https://www.facilitiesdive.com/news/Polyloom-accused-stopping-Grassroots-webinar-turf-health-impacts/751984/.

"How Far Can a Blanket Statement Go? Environmental Group Files anti-SLAPP Suit Responding to Defamation Suit Over PFAS Statement." *Dechert Re:Torts*, June 30, 2025. https://www.dechert.com/knowledge/re-torts/2025/6/how-far-can-a-blanket-statement-go--environmental-group-files-an.html.

"Lawsuit Halts Turf Safety Talk as Scientists Face Legal Threats Over PFAS Concerns." *Environmental Health News*, June 18, 2025. https://www.ehn.org/lawsuit-halts

Polyloom Corporation of America v. Grassroots Environmental Education, Inc., No. 1:2025cv00014, U.S. District Court for the Eastern District of Tennessee, filed January 20, 2025. https://dockets.justia.com/docket/tennessee/tnedce/1:2025cv00014/117538.

People v. Beaulieu Group, LLC, Case No. RG08407310, Superior Court of California, County of Alameda, Consent Judgment, signed and entered December 15, 2008. https://oag.ca.gov/system/files/media/People%20V.%20Beaulieu%20Group,%20LLC%20Consent%20Judgment,%20Signed,%20Entered.pdf

People v. FieldTurf USA, Inc., Case No. RG08407310, Superior Court of California, County of Alameda, Consent Judgment, signed and entered December 15, 2008. https://oag.ca.gov/system/files/media/People%20v.%20FieldTurf%20USA%20Consent%20Judgment%20Signed,%20Entered.pdf

Public Employees for Environmental Responsibility (PEER). *Complaint of Deceptive and Unfair Advertising of Artificial Turf.* Report No. 145028439. Federal Trade Commission, February 28, 2022. https://peer.org/wp-content/uploads/2022/03/3_7_22-Filed-

"Riverkeeper Sues Shaw Industries Over PFAS Pollution." *Congaree Riverkeeper*, July 2, 2024. https://www.congareeriverkeeper.org/riverkeeper-sues-shaw-industries-over-pfas-pollution.

"Shaw and Mohawk PFAS Lawsuit." *Paul LLP Trial Attorneys*, https://paulllp.com/mass-torts/pfas-in-carpets/.

"Shaw Flooring Complaints Mounting Among Consumers." *ClassAction.org*, April 3, 2012. https://www.classaction.org/blog/shaw-flooring-complaints-mounting-among-consumers.

"Synthetic Turf Lawsuits: Can Artificial Grass Cause Cancer?" *ClassAction.org*, May 1, 2020. https://www.classaction.org/artificial-turf-lawsuit.

Tabuchi, Hiroko, and Ken Belson. "Is Fake Grass Safe? A Manufacturer Sues to Stop a Discussion." *The New York Times*, June 17, 2025. https://www.nytimes.com/2025/06/17/climate/artificial-turf-grass-lawsuit-defamation-health-risk.html.

Safety Surface

International Play Equipment Manufacturers Association (IPEMA). "Home." https://ipema

"Synthetic Rubber." Wikipedia, https://en.wikipedia.org/wiki/Synthetic_rubber.

U.S. Consumer Product Safety Commission. "Public Playground Safety Handbook." Publication 325. December 29, 2015. https://www.cpsc.gov/s3fs-public/325.pdf.

Safety Surface – In the News

"Department of Labor Finds One of the Largest Makers of Reclaimed Rubber Flooring Exposed Austin-Area Employees to Willful, Serious Safety Violations." Occupational Safety and Health Administration, July 15, 2024. https://www.osha.gov/news/newsreleases/region6/07152024.

Miller, Eric. "Philadelphia Judge Rejects $25M Jury Verdict in Truck Crash." *Transport Topics,* April 18, 2024. https://www.ttnews.com/articles/truck-crash-award-rejected.

Recycled Plastic Lumber

Fisher, Ryan. "Recycled Plastic Lumber." Reliance Foundry Blog, September 21, 2023. Accessed October 30, 2024. https://www.reliance-foundry.com/blog/recycled-plastic-lumber?srsltid=AfmBOooHij3CFtB7Azzk3TcHffBtMAMKvIkNyebxuD3lR8zuBtQb5q7S.

Pearce, Jonathon. "Recycled Plastic Lumber: A More Sustainable Alternative to Timber." *PBC Today,* September 15, 2023. https://www.pbctoday.co.uk/news/mmc-news/recycled-plastic-lumber-timber-alternative/132504/

Reinprecht, Ladislav, and Ján Iždinský, eds. *Composites from Recycled and Modified Woods: Technology, Properties, Application.* Special Issue of Forests. Basel, Switzerland: MDPI, 2020.

--- "Genuine Stories: POLYWOOD." POLYWOOD Furniture. Accessed October 30, 2024. https://www.polywood.com/get-inspired/genuine-stories/polywood.html.

Recycled Plastic Lumber – In the News

Engstrom, Jenn, and Celeste Meiffren-Swango. "Turning Plastic Waste into Plastic Lumber Isn't Recycling." *PIRG,* March 20, 2024. https://pirg.org/articles/turning-plastic-waste-into-plastic-lumber-isnt-recycling/.

"Trex Settles Class Action Lawsuit." *RTTNews*, July 31, 2009. https://www.rttnews.com/1024441/trex-settles-class-action-lawsuit-quick-facts.aspx?Arch=1.

Company Statements

(Disclaimer: the companies mentioned in this section are not necessarily the companies identified in the research component of this report)

Permeable Paver

"Fighting Against Forced Labour and Child Labour in Supply Chains Act." Unilock Ltd., December 1, 2022–November 30, 2023. https://commercial.unilock.com/wp-content/uploads/sites/3/2025/07/Unilock-Bill-S211-Anti-Slavery-2025.pdf.

"LEED Certification: Paving the Way Leed to Sustainability." Wausau Tile. https://wausautile.com/Content/LEED.cfm.

"Reducing Embodied Carbon." Unilock Commercial,https://commercial.unilock.com/reducing-embodied-carbon/.

"Sustainability at Hanover" Hanover Architectural Products. https://hanoverpavers.com/sustainability/.

"Sustainability." ROMEX Hardscapes. https://romexhardscapes.com/sustainability/.

"Wausau Tile LEED Reference Guide." Wausau Tile, Inc., 2009. https://sweets.construction.com/swts_content_files/1887/381425.pdf.

"2016 Compliance Disclosure." Wausau Tile, Inc., 2016. https://wausautile.com/media/pdf/2016-Compliance-Disclosure.pdf.

"100% Natural & Sustainable." Cambridge Pavers, https://www.cambridgepavers.com/dfiles/cambridge_pavers_gogreen.pdf.

Geotextile Filter Fabric

https://upenn.app.box.com/file/1960333823637

"California Supply Chains Act." Sika, https://usa.sika.com/en/about-us/california-supply-chains-act.html

"Code of Conduct for Business Partners." Solmax. https://www.solmax.com/us/en/code-of-conduct.

"Environmental Sustainability Policy." Solmax, 2022. https://www.solmax.com/us/en/environmental-sustainability-policy.

"Global Human Rights Policy." HanesBrands Inc., June 2023. https://hbisustains.com/wp-content/uploads/2023/06/Human-Rights-Policy-June-2023.pdf.

"Human Rights." Sika, https://www.sika.com/en/sustainability/social-dimension/human-rights.html.

"Sika Sustainability Report 2024." Sika, 2024. https://www.sika.com/dms/getdocument.get/b0a603f9-a129-4ac5-bad1-5b00fe13ec7e/glo-ar-24-sustainability-report.pdf.

Synthetic Turf

"Helping Partners Achieve Sustainability Goals." Shaw Sports Turf, April 22, 2020. https://shawsportsturf.com/en-us/resources/news/helping-partners-achieve-sustainability-goals.

"Numerous Eco-Friendly Benefits of Artificial Grass Empower Users to Reduce Our Carbon Footprint." ForeverLawn. https://www.foreverlawn.com/media/news/stc-article/.

"Shaw Industry Group, Inc.'s Modern Slavery and Child Labor in the Supply Chain Statement for Financial Year 2023." Shaw Industries Group, Inc., May 31, 2024. https://shawinc.com/modernslaverystatement.

"Sustainability." Sprinturf. https://www.sprinturf.com/sustainability/

"Sustainability." SYNLawn, https://www.synlawn.com/about-us/sustainability/.

Safety Surface

"Sustainable Manufacturing." Sutcliffe Play. https://sutcliffeplay.co.uk/about-us/sustainable-manufacturing/

Plastic Lumber

https://upenn.app.box.com/file/1960333838037

"CMI's Environmental, Social, Governance (ESG) Impact." CMI Limited Co., accessed September 5, 2025. https://www.cmilc.com/esg.

"Impact of Plastic on the Environment." Plastic Lumber Yard. https://plasticlumberyard.com/plastic-lumber/environmental-impact/.

"Statement About Modern Slavery, Forced Labor, Human Trafficking, and Child Labor 2024." Trelleborg AB, May 30, 2024. https://www.trelleborg.com/-/media/group/about-us/code-of-conduct/statement-about-modern-slavery-forced-labor-human-trafficking-and-child-labor-2024.pdf?rev=64df0e4576ea4a3baaa23841075b64be

SUPPLY CHAIN MAPPING

Supply Chains and Trade Data

Anzoom, Rashid, Rakesh Nagi, and Chrysafis Vogiatzis. "Uncovering Illicit Supply Networks and Their Interfaces to Licit Counterparts through Graph-Theoretic Algorithms." *IISE Transactions* 56, no. 3 (March 3, 2024): 224–240. https://doi.org/10.1080/24725854.2022.2162169.

California Department of Justice. "California Transparency in Supply Chains Act (SB 657)." Last modified October 4, 2025. https://oag.ca.gov/SB657.

Cho, Kimin, Benjamin Goldstein, Dimitrios Gounaridis, and Joshua P. Newell. "Where Does Your Guacamole Come From? Detecting Deforestation Associated with the Export of Avocados from Mexico to the United States." *Journal of Environmental Management* 278 (2021): 111482. https://doi.org/10.1016/j.jenvman.2020.111482.

Dai, Lili, Rui Dai, Lilian Ng, and Zihang Peng. "Global Outsourcing and Voluntary Disclosure." *Journal of Business Finance & Accounting* 45, no. 3-4 (2018): 846-879. https://doi.org/10.1111/jbfa.12773.

Gold, Stuart, Angela Trautrims, and Zach Trodd. "Modern Slavery Challenges to Supply Chain Management." *Supply Chain Management: An International Journal* 20, no. 5 (2015): 485–494. https://doi.org/10.1108/SCM-03-2015-0124.

GOV.UK. Transparency in Supply Chains: A Practical Guide. London: UK Government, 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/649906/Transparency_in_Supply_Chains_A_Practical_Guide_2017.pdf.

Jacobs, Brian W., and Vinod R. Singhal. "The Effect of the Rana Plaza Disaster on Shareholder Wealth of Retailers: Implications for Sourcing Strategies and Supply Chain Governance." *Journal of Operations Management* 33, no. 1-2 (2017): 52-66. https://doi.org/10.1016/j.jom.2017.01.002.

LeBaron, Genevieve. "The Role of Supply Chains in the Global Business of Forced Labour." *Journal of Supply Chain Management* 57, no. 2 (2023): 29-42. https://doi.org/10.1111/jscm.12345.

Salcito, Kendyl. "Automotive Supply Chain Links to the Uyghur Genocide: Reversing a Growing Crisis." *Business and Human Rights Journal* (2023) 8, 265-270. https://doi.org/10.1017/bhj.2023.15.

Stevenson, Mark, and Robert Cole. "Modern Slavery in Supply Chains: A Secondary Data Analysis of Detection, Remediation and Disclosure." *Supply Chain Management: An International Journal* 23, no. 2 (2018): 81–99. https://doi.org/10.1108/SCM-11-2017-0382.

Wiedmer, Robert, Zachary S. Rogers, Mikaella Polyviou, Carlos Mena, and Sangho Chae. "The Dark and Bright Sides of Complexity: A Dual Perspective on Supply Network Resilience." *Journal of Business Logistics* 42, no. 3 (2021): 336–359. https://doi.org/10.1111/jbl.12264.

Supply Chain Mapping in Architecture and the Building Industry

Aigbavboa, Clinton, Wellington Thwala, and Douglas Aghimien. "Towards a Sustainable Construction Industry: The Role of Innovation and Digitalisation." 2023. *Proceedings of the 12th Construction Industry Development Board Postgraduate Research Conference*. Springer International Publishing AG.

-

Attia, El-Awady, Ali Alarjani, Md. Sharif Uddin, and Ahmed Farouk Kineber. 2023. "Examining the Influence of Sustainable Construction Supply Chain Drivers on Sustainable Building Projects Using Mathematical Structural Equation Modeling Approach." *Sustainability* 15, no. 13: 10671. https://doi.org/10.3390/su151310671.

Cho, Kimin, Benjamin Goldstein, Dimitrios Gounaridis, and Joshua P. Newell. "Hidden Risks of Deforestation in Global Supply Chains: A Study of Natural Rubber Flows from Sri Lanka to the United States." *Journal of Cleaner Production* (2022). https://doi.org/10.1016/j.jclepro.2022.131275.

Datta, Debanjan, Nathan Self, John Simeone, Amelia Meadows, Willow Outhwaite, Linda Walker, Niklas Elmqvist, and Naren Ramakrishnan. "TimberSleuth: Visual Anomaly Detection with Human Feedback for Mitigating the Illegal Timber Trade." *Information Visualization* 22, no. 3 (2023): 223–245. https://doi.org/10.1177/14738716231157081.

Dickinson, Susannah, Kirk Dimond, and Shujuan Li. "Green Waste to Green Architecture: Optimizing Urban Tree Systems for Renewable Construction Material Supply Chains." *Socio-Ecological Practice Research* 5 (2023): 263–273. https://doi.org/10.1007/s42532-023-00151-z.

Du, Qiang, Tingting Hao, Youdan Huang, and Yunquing Yan. "Prefabrication Decisions of the Construction Supply Chain under Government Subsidies." *Environmental Science and Pollution Research* 29, no. 20 (2022): 59127–59144. https://doi.org/10.1007/s11356-022-19861-0.

Hubmann, Georg, and Vera van Maaren. "Circular Practices in Construction." *Journal of Physics: Conference Series* 2600 (2023): 192017. https://doi.org/10.1088/1742-6596/2600/19/192017.

Hutton, Jane. *Reciprocal Landscapes: Stories of Material Movement.* (New York: Routledge, 2020).

Life Cycle Initiative, UNEP, and Social Alliance. 2020. Guidelines for Social Life Cycle Assessment of Products and Organizations 2020. Nairobi: UNEP. https://www.lifecycleinitiative.org/wpcontent/uploads/2021/01/Guidelines-for-Social-Life-Cycle-Assessment-of-Products-and-Organizations-2020-22.1.21sml.pdf.

Life Cycle Initiative, UNEP and Social Alliance. 2021. Methodological Sheets for Subcategories in Social Life Cycle Assessment (S-LCA). Nairobi: UNEP. https://www.lifecycleinitiative.org/wpcontent/uploads/2021/12/Methodological-Sheets_2021_final.pdf.

Jarzombek, Mark, and Vikramaditya Prakash. *A House Deconstructed.* (New York: Actar, 2023).

Mesa, Harrison A., Keith R. Molenaar, and Luis F. Alarcón. "Exploring Performance of the Integrated Project Delivery Process on Complex Building Projects." International Journal of Project Management 34, no. 7 (2016): 1089-1101. https://doi.org/10.1016/j.ijproman.2016.05.007.

Moe, Kiel. *Empire, State & Building.* (New York: Actar, 2017).

Mohamed Abdul Ghani, N. Muhammad Aslam, Gokhan Egilmez, Murat Kucukvar, and M. Khurrum S. Butta. "From Green Buildings to Green Supply Chains: An Integrated Input-Output Life Cycle Assessment and Optimization Framework for Carbon Footprint Reduction Policy Making." *Management of Environmental Quality* 28, no. 4 (2017): 532-548. https://doi.org/10.1108/MEQ-12-2015-0211.

Nusa, F. N. M., C. M. M. Isa, S. H. A. Rahman, N. F. Tarudin, N. D. Mohamad, N. S. M. Soffi, M. M. Mohamad, S. F. Fam, and C. N. Preece. "The Challenges of Green Supply Chain Management (GSCM) System Implementation in Civil Construction Projects." *IOP Conference Series: Earth and Environmental Science* 1151, no. 1 (2023): 012011. https://doi.org/10.1088/1755-1315/1151/1/012011.

Oyefusi, Oluwatobi Nurudeen, Wilfred I. Enegbuma, A. Brown, and M. P. Zari. "Regenerative-Based Green Supply Chain Management Model for the Construction Industry." *IOP Conference Series: Earth and Environmental Science* 1101, no. 8 (2022): 082028. https://doi.org/10.1088/1755-1315/1101/8/082028.

Xie, Danfeng, Jian Xin, Hongyan Wang, and Lei Xiao. "Identifying Critical Factors Affecting the Resilience of Additive Manufacturing Architecture Supply Chain." *Buildings* 13, no. 4 (2023): 997. https://doi.org/10.3390/buildings13040997.

Yu, Wenhui, "Supply Chain's Function in Improving the Building Industry Innovation." In Applied Informatics and Communication, edited by J. Zhang, 227. ICAIC 2011. *Communications in Computer and Information Science*. Berlin and Heidelberg: Springer. (2011) https://doi.org/10.1007/978-3-642-23226-8_75.

Zhang, Na, and Ke Bin Lu. "The Evolutionary Game and Simulation of Key Players in the Green Supply Chain of Construction Industry." *Modern Supply Chain Research and Applications* 4, no. 3 (2021): 225-240. https://doi.org/10.1108/MSCRA-01-2022-0003.

Supply Chain Compliance

Adidas. "Global Policy Manual: Responsible Sourcing & Purchasing Policy." Accessed October 22, 2024 https://res.cloudinary.com/confirmed-web/raw/upload/v1706098803/adidas-group/sustainability/policies/adidas_responsible_sourcing__purchasing_policy_vh17ni.pdf.

Adidas. "Modern Slavery: A Policy Framework & Implementation Strategy." Accessed October 22, 2024 https://res.cloudinary.com/confirmed-web/raw/upload/v1706098635/adidas-group/sustainability/policies/adidas_policy_on_modern_slavery_2023_tbxscz.pdf

LeBaron, Genevieve, Jane Lister, and Peter Dauvergne. "Governing Global Supply Chain Sustainability through the Ethical Audit Regime." *Globalizations* 14, no. 6 (2017): 958–975. https://doi.org/10.1080/14747731.2017.1304008.

Russell, Elizabeth, James Lee, and Roland Clift. "Can the SDGs Provide a Basis for Supply Chain Decisions in the Construction Sector?" *Sustainability* 10, no. 3 (2018): 629. https://doi.org/10.3390/su10030629.

Wen, Shuangge. "The Cogs and Wheels of Reflexive Law—Business Disclosure under the Modern Slavery Act." *Journal of Law and Society* 43, no. 3 (2016): 327–359. https://doi.org/10.1111/jols.12005.

Veriforce CHAS. "Spotting and Stopping Modern Slavery in Construction." London: Veriforce CHAS, 2021. https://www.chas.co.uk/help-advice/risk-management-compliance/csr-in-construction/spot-stop-modern-slavery-construction/. See also https://www.chas.co.uk/contractors/common-assessment-standard/.

Import Genius

Import Genius is an online database company in the space of supply chain audits. The following sources identify the appearance of this company in the press, as well as announcements made by the company regarding their various products.

"Import Genius Partners with Postmark App to Deliver E-Mail Alerts." *PRWeb Newswire*, August 17, 2011. Gale General OneFile (accessed August 6, 2024). https://link-galecom.proxy.library.upenn.edu/apps/doc/A264450141/ITOF?u=upenn_main&sid=summon&xid=50a79e28.

"Import Genius Brings Trade Data to Arizona Tech Council Members." PRWeb Newswire. 2011. Gale General OneFile. May 13, 2011 (accessed August 6, 2024.) https://link.gale.com/apps/doc/A256255010/ITOF?u=upenn_main&sid=summon&xid=187f18a.

"International Trade Databases Help UK Businesses Reach New Markets, According to Import Genius." *Internet Wire*, July 5, 2012. Gale General OneFile (accessed August 6, 2024). https://linkgalecom.proxy.library.upenn.edu/apps/doc/A295326784/ITOF?u=upenn_main&sid=summon&xid=fc889497.

"United Shipping Taps Import Genius Data on Ocean Shipping." *PRWeb Newswire*, January 3, 2011. Gale General OneFile. (Accessed August 6, 2024.) https://link.gale.com/apps/doc/A245664671/ITOF?u=upenn_main&sid=summon&xid=5641e947

Sayari.com

Sayari is an online database company in the space of supply chain audits. The following sources identify the appearance of this company in the press, as well as announcements made by the company regarding their various products.

Armental, Maria. "TPG Acquires Supply-Chain Risk Company Sayari Labs; Sayari, Which Has Government and Commercial Customers, Plans to Launch a New Artificial Intelligence-Enhanced Product for

Supply-Chain Risk Management." *Wall Street Journal*, January 16, 2024. ProQuest

Legal Monitor Worldwide. "Sayari Labs Raises $40M to Boost Trade Transparency." Gale General OneFile, September 15, 2021. https://link.gale.com/apps/doc/A675445317/ITOF?u=upenn_main&sid=summon&xid=5304e22e (accessed August 25, 2024).

Plus Company Updates. "TPG to Invest $228M in Sayari." Gale General OneFile, January 17, 2024. https://link.gale.com/apps/doc/A780639379/ITOF?u=upenn_main&sid=summon&xid=134f3796 (accessed August 25, 2024).

PR Newswire Europe. "Sayari Partners with GAN Integrity to Combat Corruption and Modern Slavery in Supply Chains." Gale OneFile: *News,* April 29, 2024. https://link.gale.com/apps/doc/A791889215/STND?u=upenn_main&sid=summon&xid=d3ae5c15 (accessed August 25, 2024).

"Sayari Announces Major Expansion of Global Supply Chain Data." *Business Wire*, May 17, 2023. Gale General OneFile. https://link.gale.com/apps/doc/A749550754/ITOF?u=upenn_main&sid=summon&xid=65356687. Accessed August 25, 2024.

"Sayari Appoints Lieutenant General (Ret.) Joseph Anderson as Newest Advisor." *PR Newswire*, June 25, 2024. Gale OneFile: News. https://link.gale.com/apps/doc/A798746653/STND?u=upenn_main&sid=summon&xid=be0964b4. Accessed August 25, 2024.

"Sayari Awarded $7.8M Enterprise Trade Analytics Contract to Support U.S. Customs & Border Protection." *Contify Investment News*, November 15, 2022. Gale OneFile: News. https://link.gale.com/apps/doc/A726751860/STND?u=upenn_main&sid=summon&xid=589015d2. Accessed August 25, 2024.

"Sayari Labs Secures $40M Series C." *PR Newswire*, September 14, 2021. Gale In Context: Biography. https://link.gale.com/apps/doc/A675315515/BIC?u=upenn_main&sid=summon&xid=2320e70d. Accessed August 25, 2024.

"Sayari Launches New Supply Chain Mapping Solution to Automate Risk Detection in Upstream Suppliers." *PR Newswire*, April 9, 2024. Gale In Context: College. https://link.gale.com/apps/doc/A789400799/CSIC?u=upenn_main&sid=summon&xid=49d6614e. Accessed August 25, 2024.

"Sayari Named to Chartis RiskTech100 2023 Annual Report." *Business Wire*, December 13, 2022. Gale General OneFile. https://link.gale.com/apps/doc/A729813670/ITOF?u=upenn_main&sid=summon&xid=79598c74. Accessed August 25, 2024.

"Sayari Ranks on Inc. 5000 List." *Wireless News*, September 5, 2023, NA. Gale General OneFile (accessed August 25, 2024). https://link-galecom.proxy.library.upenn.edu/apps/doc/A763441124/ITOF?u=upenn_main&sid=summon&xid=23888041.

"Sayari Supports Atlantic Council Investigation into Chinese Economic Coercion." *Business Wire*, November 13, 2023. Gale General OneFile. https://link.gale.com/apps/doc/A772559836/ITOF?u=upenn_main&sid=summon&xid=3f60562e. Accessed August 25, 2024.

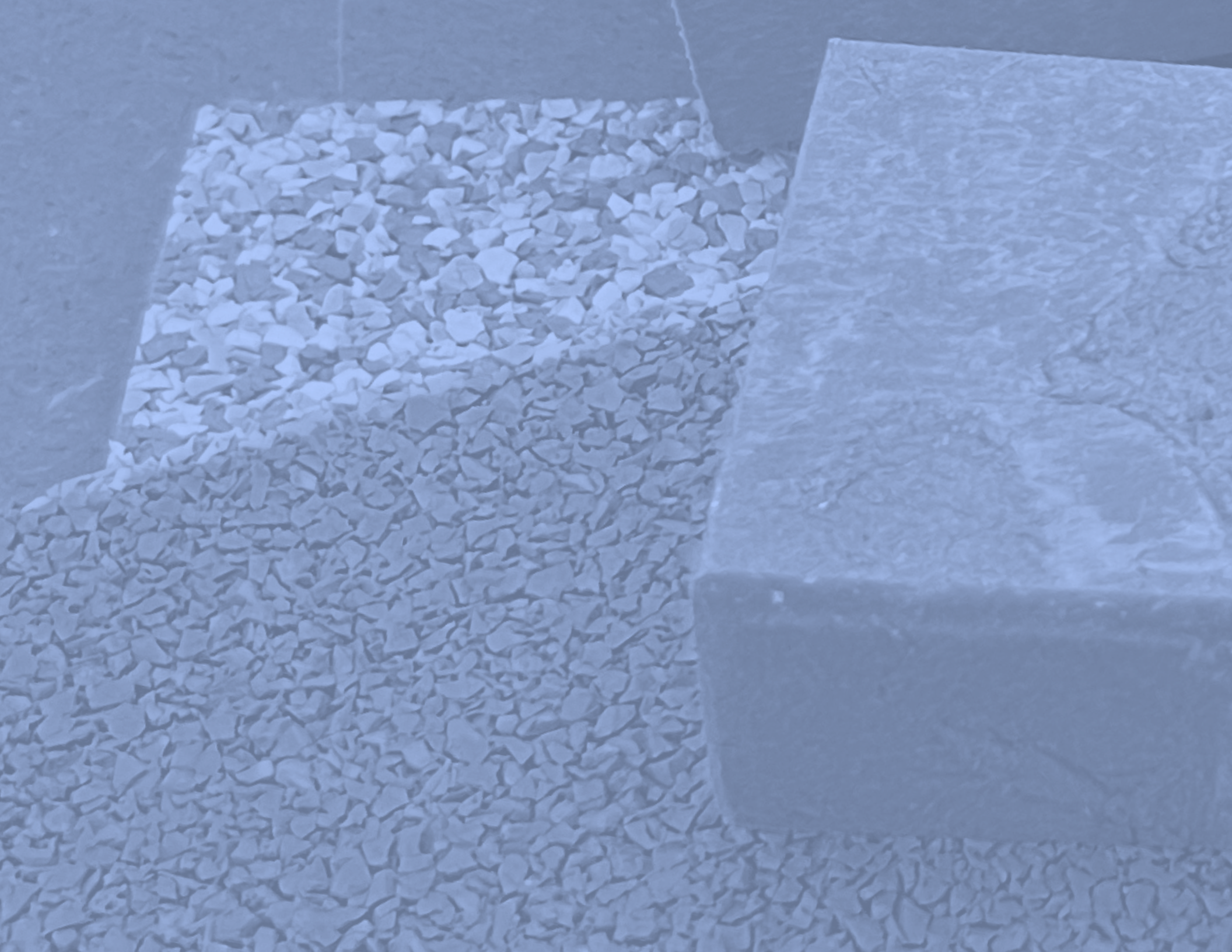
"Sayari Welcomes Enterprise Software, Data, and Analytics Leader Steve Nguyen to Accelerate U.S. Government Business." *AP* Online, February 22, 2024. Gale In Context: Global Issues. https://link.gale.com/apps/doc/A783708041/GIC?u=upenn_main&sid=summon&xid=99475adb. Accessed August 25, 2024.

"Sayari Welcomes U.S. Special Operations Command Executive James Smith to Advisory Board." *PR Newswire*, July 30, 2024. Gale General OneFile. https://link.gale.com/apps/doc/A803064199/ITOF?u=upenn_main&sid=summon&xid=6a433d03. Accessed August 25, 2024.

"TPG Announces $228 Million Strategic Growth Investment in Sayari." *Contify Investment* News, January 16, 2024. Gale OneFile: News. https://link.gale.com/apps/doc/A779587266/STND?u=upenn_main&sid=summon&xid=a8b4d65d. Accessed August 25, 2024.

"U.S. Department of Labor Selects Sayari to Combat Forced Labor." *AP Online*, January 4, 2024. https://link.gale.com/apps/doc/A778369287/ITOF?u=upenn_main&sid=summon&xid=e8d4b402

This page is intentionally left blank



8.0 Appendix

Appendix

UPENN RESEARCH TEAM

Dr. Franca Trubiano, PhD.

Franca Trubiano is Graduate Group Chair of the Ph.D Program in Architecture and associate professor at the Weitzman School of Design of the University of Pennsylvania. She received her Ph.D from Penn in the History and Theory of Architecture and is a Registered Architect with l'Ordre des Architects du Quebec. Since 2021, she has co-directed Penn's Mellon funded, Humanities+ Urban + Design Initiative, The Inclusive City. Trubiano is co-editor of *BIO/MATTER/TECHNO/ SYNTHETICS – Design Futures for the More than Human* (ACTAR 2024), the author of *Building Theories, Architecture as the Art of Building* (Routledge 2023), and co-editor of *Women [Re] Build; Stories, Polemics, Futures* (ORO, 2019). Her edited book *Design and Construction of High-Performance Homes: Building Envelopes, Renewable Energies, and Integrated Practice* (Routledge Press 2012), was translated into Korean and awarded the 2015 Sejong Outstanding Scholarly Book Award. Trubiano was awarded the 2025 ARCC James Haecker Award for Distinguished Leadership in Architectural Research. She conducts funded research on 'Forced Labor in the Building Industry,' as well as on 'Fossil Fuels, the Building Industry, and Human Health.'

Ivanna Dudych

Ivanna Dudych is a fourth-year undergraduate at the University of Pennsylvania, double-majoring in Architecture and Fine Arts. As part of the research team, she helped collate and analyze the information presented in this report. After graduation, she plans on pursuing a Master's in Architecture and continuing to cultivate a design approach rooted in material awareness and "slow architecture."

MNLA RESEARCH TEAM

Signe Nielsen, RLA, FASLA

Signe is a Founding Principal of MNLA and has been practicing as a landscape architect and urban designer in New York since 1978. Her body of work has renewed the environmental integrity and transformed the quality of spaces for those who live, work, and play in the urban realm. A Fellow of the ASLA, she is the recipient of more than 100 national and local design awards for public open space projects and is published extensively nationally and internationally. Signe is a professor of urban design and landscape architecture at Pratt Institute in both the graduate and undergraduate Schools of Architecture and is the former President of the Public Design Commission of the City of New York. Born in Paris, Signe received a Bachelor of Arts, cum laude, in Urban Planning from Smith College; a Bachelor of Arts in Landscape Architecture from City College of New York; and a Bachelor of Science in Construction Management from Pratt Institute.

Noriko Maeda, RLA, ASLA, WEDG

Noriko is a Senior Associate at MNLA who joined the firm in 2008. She brings over 27 years of experience in urban design and planning to the firm. Expert at managing complex efforts with multiple stakeholders, she is highly skilled at balancing both project goals and design excellence. Noriko has lead multi-disciplinary teams on streetscape improvements, waterfront parks, plazas from schematic design to construction support services. She is also a fine artist whose work has been exhibited both in Japan and Hawaii. Noriko received a Master of Landscape Architecture from the State University of New York College of Environmental Science and Forestry and a Bachelor of Fine Arts from the Tokyu Zokei University. She has been a guest lecturer at the Bauhaus in Germany and currently serves as an associate adjunct professor at the New York City College of Technology.

MNLA RESEARCH TEAM

Amy Arato, RLA, ASLA, ISA, WEDG
Amy is a Senior Landscape Architect with 10 years of experience that encompasses a wide variety of project scales in both the public and private realms. Her recent work to update MNLA's QAQC standards facilitates the team's efforts in formulating specifications language to actualize transformation.

Emily Silber, RLA, ASLA
Emily is a Landscape Architect who works collaboratively to build transformative waterfronts, plazas, parks, streetscapes, and neighborhoods. As part of the research team, Emily fosters outside collaboration with advisors and researchers as well as studies mechanisms to support building with fair labor.

Jeb Polstein, WEDG
Jeb Polstein is a Senior Landscape Designer with a background in land restoration and urban planning. His work at MNLA has focused on climate resilience across scales, from neighborhood-wide flood protection to adaptive planting design. Jeb's role on the Ethically Sourcing team includes leading the mapping effort.

Lee Williams, RLA, WEDG
Lee is a Landscape Architect who believes in using design to reveal and celebrate ecology and culture. Drawing from her experiences in architecture, art and the outdoors, her work focuses on material performance, climate resiliency and landscape as infrastructure in rapidly urbanizing areas. Lee's role in the research team includes transforming research and data into a graphic language.

8.2 LIST OF ACRONYMS

2-EHA	2-Ethylhexanoic Acid
3TG	Tin, Tantalum, Tungsten, or Gold
ACE	Architecture, Engineering, and Construction
AGC	Associated General Contractors of America
AHO	Oslo School of Architecture and Design
APC1	Architectural Products Co. 1
ARCC	Architectural Research Centers Consortium
ASI	Aluminum Stewardship Initiative
ASLA	American Society of Landscape Architects
ASPI	Australian Strategic Policy Institute
ASTM	American Society for Testing and Materials
BASF	Badische Anilin- & Soda-Fabrik
BES	Building Research Establishment (BRE) Environmental Standard
BIFMA	Business and Institutional Furniture Manufacturers Association
BREEAM	Building Research Establishment Environmental Assessment Method
BWI	Building and Wood Worker's International
CAATSA	Countering America's Adversaries Through Sanctions Act
CAHRA	conflict-affected and high-risk area
CBP	U.S. Customs and Border Protection
CCA	Canadian Construction Association
CCP	Chinese Communist Party
CEO	Chief Executive Officer
CICA	Confederation of International Contractors' Associations
CIOB	Chartered Institute of Building
CMSA	Canadian Modern Slavery Act
COVID	Coronavirus Disease
CSC	Concrete Sustainability Council
CSI	Construction Specifications Institute
CSR	Corporate Social Responsibility
DEPT	Department
DFF	Design for Freedom
DHS	Department of Homeland Security
DOB	Department of Buildings
DOI	Digital Object Identifier
DOL	US Department of Labor
DOT	Department of Transportation
E.S.G.	Environmental, Social, and Corporate Governance
EAAE	European Association for Architectural Education
EBRD	European Bank for Reconstruction and Development
ECCHR	European Center for Constitutional and Human Rights
EIFS	Exterior Insulation and Finish System
EIS	Environmental Impact Statement
EPD	Environmental Product Declaration
EPDM	Ethylene Propylene Diene Monomer
EPS	Extruded Polystyrenes
ESG	Environmental, Social, and Corporate Governance
ESRI	Environmental Systems Research Institute
ESV	Environmental & Social Value
ETI	Ethical Trading Initiative
EU	European Union
EWF	Engineered wood fiber
FAR	Federal Acquisition Regulation
FASLA	Fellow of the American Society of Landscape Architects.
FAST	Finance Against Slavery and Trafficking
FDR Park	Franklin Delano Roosevelt Park
FIEC	European Construction Industry Federation
FIFA	The International Football Federation
FLSA	Fair Labor Standards Act
FOIL	Freedom of Information Law
FSC	Forest Stewardship Council
G20	The Group of Twenty
GEO	Geotextile Filter Fabric
GFLC	Governing Forced Labour in Supply Chains
GISC	Global Impact Sourcing Coalition
GLAA	Gangmasters & Labour Abuse Authority
GPSNR	Global Platform for Sustainable Natural Rubber
GSAPP	Columbia University Graduate School of Architecture, Planning and Preservation
GSCM	Green Supply Chain Management
GSI	Global Slavery Index
GTAS	Global Trade Atlas System
HDPE	High-Density Polyethylene
HPD	Health Product Declarations
HRIAM	Human Rights Impact Assessment and Management
HRW	Human Rights Watch
HS Code	Harmonized System Code
HSBC	The Hongkong and Shanghai Banking Corporation Limited
ICC-ES	International Code Council Evaluation Service
ICSA	International Conference on Structures and Architecture
ICT	Information and Communication Technology
IE	Independent Evaluations

IFAWPCA	International Federation of Asian and Western Pacific Contractors' Associations
ILFR	International Labor Rights Fund
ILO	International Labour Organization
IOP	Institute of Physics
IPEMA	International Play Equipment Manufacturers Association
IRMA	Initiative for Responsible Mining Assurance
ISA	International Society of Arboriculture
JV	Joint Venture
LAF	Landscape Architecture Foundation
LCA	Life Cycle Assessment
LDPE	Low-Density Polyethylene
LEED	Leadership in Energy and Environmental Design
LLC	Limited Liability Company
mHREDD	Mandatory human rights and environmental due diligence
MNLA	Mathews Nielsen Landscape Architects
NAHB	National Association of Home Builders
NFL	National Football League
NGO	non-governmental agencies
NJASLA	New Jersey Chapter of the American Society of Landscape Architects
No.	Number
NYASLA	New York Chapter of the American Society of Landscape Architects
NYC Parks	New York City Department of Parks and Recreation
OATH	Office of Administrative Trials and Hearings
OFAC	Office of Foreign Assets Control
OSHA	Occupational Safety and Health Administration
OWP	The Organization for World Peace
PE	Polyethylene
PFAS	Per- and Polyfluoroalkyl Substances
PIP	Poured-in-place
PL	Recycled Plastic Lumber
PP	Permeable Pavers
PP	Polypropylene
PSA	Possibly the Same as
PU	Polyurethanes
PVC	Polyvinyl Chloride
RBA	Responsible Business Alliance
RLA	Registered Landscape Architect
RPL	Recycled Plastic Lumber
RST	Responsible Sourcing Tool
SAI	Social Accountability International
SBR	Styrene Butadiene Rubber
Scert	Supplier Certification
SCM	Supply Chain Management
SDN List	Specially Designated Nationals List
SEDEX	Supplier Ethical Data Exchange
SFI	Sustainable Forestry Initiative
SITES	Sustainability rating system for landscapes
SLAPP	Strategic Lawsuit Against Public Participation
S-LCA	Social Life Cycle Assessments
SPOTT	Sustainability Policy Transparency Toolkit
SS	Rubber Safety Surface
ST	Synthetic Turf
STRT	Slavery & Trafficking Risk Template
TFTEA	The Trade Facilitation and Trade Enforcement Act
TISC	Transparency in Supply Chains Report
TPV	Thermoplastic Vulcanizate
UFLPA	Uyghur Forced Labor Prevention Act
UNEP	United Nations Environment Program
UPENN	University of Pennsylvania
USADA	United States Anti-Doping Agency
USAID	United States Agency for International Development
USCC	Uniform Social Credit Code
USDA	United States Department of Agriculture
UV	Ultraviolet
WRO	Withold Release Orders
XPCC	Xinjiang Production and Construction Corps
XUAR	Xinjiang Uyghur Autonomous Region

8.3 LIST OF FIGURES

SECTION 6

* denotes the figures derived from sources that were not specifically developed for this research