Background Lead and Arsenic Surface Soil Levels

Indianapolis, Indiana

June and July 2017

Introduction

The *Remediation Closure Guide, Chapter 6, Conceptual Site Model Development: Background and Off-site Sources* (2012) provided guidance for evaluating site conditions that are not associated with site activities. The Indiana Department of Environmental Management (IDEM) is aware that sometimes soil contamination originates through air deposition as a result of historic human activities or as naturally occurring, and the site owner is not responsible for remediation or closure relative to these conditions. "*IDEM recognizes the potential value of regional or state-wide background studies as a cost-effective approach for many smaller sites and welcomes the opportunity to collaborate with stakeholders in the design and execution of such studies."* [1]

IDEM and the Midwestern States Environmental Consultants Association (MSECA) collaborated to obtain lead and arsenic urban background soil values for Indianapolis, Indiana. This project was a continuation of the Background Soils Study conducted by IDEM, MSECA and Indiana University-Purdue University Indianapolis (IUPUI) for Terre Haute, Indiana in 2014.

The list of constituents was selected based on frequency of investigation, the likeliness of having background levels in the environment, and the relatively low screening criteria for these constituents. Due to budgetary constraints, metals were limited to lead and arsenic.

Scope

Due to its size and number of sites, Indianapolis was selected as the next investigative area. All soil samples were collected from property owned by the City of Indianapolis under the approval of the City's Parks and Recreation Department. IDEM obtained property access and the Consent for Access is in Appendix A. The properties selected for sampling had probable long-term undisturbed soil and were not underlain by waste material. The specific locations were selected based on locational criteria specified in the *Sampling Plan for Indianapolis Background Soils, September, 2015.* The site list and sampling plan are attached to the Access agreement as Exhibits A and B.

Sampling Methodology and Locations

All surface sampling was conducted following the *Sampling Plan* with few exceptions. Note that the internet address of the Spatial Data Collection Standards was changed to https://www.in.gov/idem/6839.htm during the intervening time between plan development and execution. IDEM samplers followed the Sampling Plan with some deviations:

1. Remediation Closure Guide, p. 97

(1) No topography or soil series information was documented on the field sheets. Natural Resources Conservation Service maps containing this information were used.

(2) All decontamination conducted on July 25, 2017 used another type of detergent than what was used at all the other sites.

(3) Also, though the sampling plan tentatively planned for 50 sites, the list of planned sites included 58 parks. Several parks were eliminated due to site conditions such as:

Acorn Park, 3300 N Sutherland Ave, could not be located.

Bel Aire Park, 2915 Tibbs Ave, was closed with no access permitted.

Bowman Park, 3600 Auburn Rd, had boundary issues.

Sandorf Park, 2020 Dawson St, location of unpermitted landfill.

Instead, two (2) samples were taken from the larger parks, Ellenberger and Garfield.

(4) Kelly Park, 1200 S Meridian St, was sampled three times on two different days (June 20 and November 6, 2017) due to impacted soil from a historic building onsite. The first set of samples yielded elevated arsenic results so IDEM elected to resample using the same composite sampling scheme at two different locations within the park. During the initial sampling event, staff observed and noted on the field sheets that it was difficult to advance the soil corer and the sample contained lots of rock and brick fragments. The first 3-5 inches were relatively homogenous while the remainder of the sampled interval contained varying sizes of brick fragments. After consultation with historical site maps, staff determined a brick school building had stood over the area where the initial sample was taken. It is apparent that the arsenic analytical results were biased high due to the inclusion of the brick remnants. The November return sampling event was carefully staged inside (composite sample # 21a-e) and outside (composite sample # 22a-e) the building footprint and the low arsenic levels from outside the building footprint are consistent with the results from the other sampled parks. Based on these lines of evidence, IDEM is confident that the shallow soil overlying the historic building debris has low arsenic levels consistent with those observed in the second round of sampling. IDEM ultimately decided to include all the sampling data from this park into the sampling database in recognition that urban background soil levels should include all data from the entire six-inch interval even when the results may be biased by a historic urban structure. This approach is consistent with the concept of urban background soils.

IDEM staff completed Sample Chain of Custody sheets and the samples were analyzed at the Office of Land Quality's (OLQ) contract laboratory, Microbac. Microbac analyzed the metals using Method 6010C.

OLQ's Chemistry Services Section received the analytical results and validated the data according to quality criteria in IDEM Laboratory Services Contract and Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Third Edition. The validation indicated the results were usable for the overall project goal. The validation information plus general locational information can be found in IDEM's Virtual File Cabinet at Document # 80540903 and # 80600969.

Results

Samples collected from this project revealed arsenic concentrations ranging from 5 to 65 with a median value of 8.5. Lead concentrations ranged from 12 to 260 and had a median value of 32.5. A summary of the arsenic results is provided as Table 1 and lead results in Table 2 in Appendix B. General Statistics including mean, median and standard deviation of these results are included in Appendix C.

Appendix C also lists the general statistics of arsenic and lead in 56 soil samples across rural Indiana taken by the USGS from the A horizon (approximately 6 to 10 inches in depth). The differences such as site specific criteria including locations (rural versus urban) and site history should be taken into account to determine the applicability of the USGS arsenic and lead background values. OLQ's Chemistry Services Section document (VFC # 80446228), identified significant differences when the USGS methodology is compared to IDEM Laboratory Services Contract, but the bias cannot be determined. The above referenced memorandum draws a conclusion that the USGS method should yield higher results. USGS background values may be utilized if methodologies and site criteria are similar to the USGS background study.

Using this Information

This report and results are specific to background sampling in Indianapolis, Indiana. Feel free to use this data as valid background data and use at your discretion. Extrapolation to other nearby cities, counties or the State may not be considered valid comparisons.

ATTACHMENTS

A – Consent for Access, Park Site List, Sampling Plan and Maps of Sample Locations

B- Sample Results

Table 1 – Arsenic

Table 2 – Lead

C – General statistics

Attachment A

– Consent for Access, Park Site List, Sampling Plan, and Maps of Sample Locations -

CONSENT FOR ACCESS TO PROPERTY FOR ENVIRONMENTAL INVESTIGATION OF BACKGOUND SOILS

This Agreement is made as of this _____day of _____, 20____, by the Consolidated City of Indianapolis, by and through its Department of Parks and Recreation ("City"), and the Indiana Department of Environmental Management ("IDEM"), together referred to as "Parties".

The City is the current owner of property in Marion County described in Exhibit A, attached hereto and incorporated by reference (the "Properties").

The City hereby consents for officers, employees, contractors, and authorized representatives of IDEM to enter and have continued access to the Properties for the purpose of collecting soil samples from the property as described in Exhibit B, attached hereto and incorporated by reference (the "Activities").

IDEM shall conduct its Activities in a manner that will not unreasonably interfere with the normal and usual business operations or recreational activities being conducted on the Properties. IDEM shall also conduct its Activities in a manner reasonably calculated to minimize disturbance to existing site conditions. Only IDEM employees will be collecting the soil samples from the Properties. IDEM will not hire any contractors or interns to perform this work.

After performing its Activities, IDEM agrees to restore the areas of the Properties that were disturbed by IDEM's Activities to, as nearly as reasonably possible, the same condition as existed on the date that such areas were disturbed by IDEM.

IDEM, by execution of this Agreement, hereby covenants that no departure shall be made from the purpose of this access, except upon express written permission of the City.

This Agreement shall commence on the date of the last signatory and terminate on December 31, 2017. The City shall have the right to cancel and terminate this Agreement by providing IDEM notice in writing at least thirty (30) days in advance.

Each of the undersigned Parties represents and warrants that it is authorized to execute this Agreement on behalf of the respective Party to the Agreement.

IN WITNESS WHEREOF, the Parties hereby execute, on the dates set forth below, the Consent for Access to Property for Environmental Investigation of Background Soils.

Consolidated City of Indianapolis
Department of Parks and Recreation

By: Linda Broadfoot
Linda Broadfoot, Director

Date: 6/9/16

Indiana Department
of Environmental Management

By:
Peggy Dorsey
Deputy Assistant Commissioner
Office of Land Quality

Date: 6/27/16

Approved as per Legal Form:

By: Robert M. Frye
Robert M. Frye
Assistant Corporation Counsel

EXHIBIT A

	Park Name	Address
1	Acorn Park	3300 N Sutherland 46218
2	Al E Polin Park	100 E 29th St 46205
3	Andrew Ramsey Park	310 W 42nd St 46208
4	Arsenal Park	1400 E 46th St 46205
5	Beckwith Memorial	2302 E 30th St 46218
6	Bel Aire Park	2915 Tibbs Ave 46222
7	Bertha Ross Park	3700 Clifton St 46208
8	Bethel Park	2850 Bethel Ave 46217
9	Bluff Park	555 W Hanna 46217
10	Bowman Park	3600 Auburn Rd 46224
11	Broadway & 61st	6051 N Broadway 46220
12	Canterbury Park	5510 Carvel Ave 46220
13	Centennial & Groff	2300 N Centennial St 46222
14	Christina Oaks Park	4205 W Washington St 46241
15	Denver Park	1024 N Sharon 46222
16	Douglass Park	1616 E 25th St 46218
17	Doris Crawford Park	4050 N Irvington 46226
18	Edna Balz Lacy Park	700 Greer St 46203
19	Elwood & Mary Black Park	4241 Fairview Terrace 46208
20	Ellenberger Park	5301 St Clair St 46219
21	Falculty Park	3307 Ashway Dr 46224
22	Frank & Judy O'Bannon	1001 E 16th St 46202
23	Garfield Park	2345 Pagoda Dr 46203
24	Gardner Park	6900 E 46th St 46226
25	Gateway West	6150 Gateway Dr 46254
26	Haughville Park	520 N. Belleview Pl 46222
27	Hawthorne Park	75 N Belleview Pl 46222
28	Highland Park	1100 E New York St 46204
29	Indianola Park	1900 W Washington St 46222
30	John Ed Park	2000 E Roosevelt Ave 46218

	Park Name	Address
31	JTV Hill Park	1806 N Columbia Ave 46206
32	Juan Solomon Park	6100 Grandview Dr 46228
33	Kelly Park	1200 S Meridian St 46225
34	Lentz Park	700 N Traub St 46222
35	MLK Jr Park	1702 N Broadway St 46202
36	Max Bahr Park	300 N Warman Ave 46222
37	McCarty Triangle	1100 W McCarty St 46221
38	Moreland Park	2935 Moreland Ave 46222
39	Olin Park	702 N Olin Ave 46222
40	Orange Park	1900 E Pleasant Run Pkwy N Dr 46203
41	Porter Playfield	404 S St Paul St 46201
42	Oscar Charleston	2800 E 30th St 46218
43	Rhodius Park	1720 W Wilkins St 46221
44	Riverwood Park	7201 Crittenden Ave 46240
45	Roselawn Park	5000 Roselawn Ave 46226
46	Ross Claypool	2300 Howard St 46221
47	Sandorf Park	2020 Dawson St 46203
48	Stringtown Park	1605 W Ohio St 46222
49	Stamm Park	1616 E 71st St 46220
50	Stout Field	3820 W Bradbury Ave 46241
51	Tarkington Park	45 W 40th St 46208
52	Thatcher Park	4649 W Vermont St 46222
53	Virginia Lee O'Brien Park	2300 N Bolton Ave 46218
54	Washington Park	3130 E 30th St 46218
55	Watson Rd Bird Preserve	900 Watson Rd 46205
56	West Montgomery Park	3400 N Hawthorne Ln 46218
57	Willard Park	1901 E Washington St 46201
58	Windsor Village Park	6510 E 25th St 46219

56 parks
58 locations

EXHIBIT B

Sampling Plan for Indianapolis Background Soils
September 15, 2015

IDEM continues its project to sample, analyze, and estimate the background concentrations of arsenic and lead in surface soils across the state of Indiana. Arsenic and lead are referenced collectively as the "constituents of interest" (COI). Identifying background concentrations of the COI is important because during remediation and/or closure it often is difficult to distinguish between COI that are present in soils as a result of releases associated with the subject closure activity versus those that are not. (The former are the responsibility of the party performing remediation/closure, whereas the latter are not.) Furthermore, risk-based screening levels for arsenic generally are lower than naturally occurring arsenic levels in soil in many regions of Indiana.

1.1 Urban Background and Minimally Disrupted Areas Background
Natural background refers to the concentrations of COI that are present in environmental media without human influence. "Minimally Disrupted Areas" (MDA) is a term used in this project to address locations where ambient concentrations of COI include those understood to be present naturally plus those that are present due to deposition through widespread human activities not associated with power generation or manufacturing (e.g., historical heating with coal, use of leaded gasoline, etc.). "Urban Background" (UB) is a term used in this project to address those locations where ambient concentrations of COI include those understood to be present naturally, plus those that are present due to deposition through widespread human activities including those activities normally associated with the presence of a high population (urban) center (e.g., historical power generation and manufacturing activities).

1.2 Objectives
The objectives of this project are to:
(i.) Collect surface soil samples that are representative of urban background conditions for analysis of the selected COIs;
(ii.) Collect surface soil samples that are representative of minimally disrupted areas for analysis of the selected COIs;
(iii.) Perform laboratory analysis of the samples to determine COI concentrations in the samples;
(iv.) Evaluate the data statistically to determine concentrations representative of the COIs in both urban and minimally disrupted areas of Indianapolis;

2.0 Sampling Strategy and Field Activities for Urban Background Determination
Sampling activities will be performed by IDEM staff with support from the Midwestern States Environmental Consultants Association (MSECA) in the manner described below.

2.1 Areas Suitable for Urban Background Sampling
Locations for urban background have been pre-selected based in part on ease of access.

Anticipated sampling locations are in selected City parks. All of the sampling sites are owned or under the jurisdiction of the City of Indianapolis, Indiana.
Specific sample locations will be selected based upon visual inspection, review of historical records, and review of IDEM site files.

Ideally, sampling locations meet the following criteria:
(i.) The surface soils are not composed of, and are not believed to have been impacted by, engineered or structural fill.
(ii.) Areas of reported or suspected spills; reported or suspected management, treatment, handling, storage, or disposal of solid or hazardous wastes or substances, including petroleum and wastewater, are excluded.
(iii.) Located more than 10 feet from edge of parking lots
(iv.) Located more than 100 feet from major roads
(v.) Located more than 20 feet from streets and minor roads
(vi.) Highly manicured lawns are excluded (e.g., golf courses)
(vii.) Not within an obvious flood plain as determined by direct visual inspection, local anecdotal reports or reference to existing flood hazard maps
(viii.) Areas along railroad tracks and associated drainage areas are excluded
(ix.) Surface water storm drains or ditches are excluded.
Major roads are defined as those segments of road where vehicular traffic counts exceed 10,000 vehicles per day.

2.2 Sampling Equipment and Personal Protective Equipment (PPE)
Surface soil samples will be collected using hand-driven soil coring devices, such as stainless steel bucket augers. Based on the composite sampling strategy (discussed below), multiple sub-samples or aliquots will be composited into one sample at each sampling location. A stainless steel mixing bowl and stainless steel spoon will be used to composite the sub-samples at each sampling location. The hand auger/soil sampler and mixing bowl/spoon will be decontaminated after sampling at each location. Decontamination is not required between sub-sampling (aliquot) locations. However the sampling probes will be wiped "clean" with a brush or paper towels to remove clumps of soil that may adhere to the equipment and thereby reduce the possibility of soil transfer from one aliquot to the other. Decontamination will consist of washing non-disposable sampling equipment (e.g., bucket augers, bowls, etc.) with a non-phosphate detergent (such as Liquinox) and brushes, and rinsing with both tap water (primary rinse) and deionized water (final rinse). PPE will include disposable nitrile gloves or similar protective gloves (such as polyethylene), and safety glasses. Gloves will be changed between each sample location.

2.3 Field Documentation
Sampling documentation will be recorded on IDEM field sampling note forms provided to the sampling team. The sampling team will record the sample aliquot locations as GPS coordinates in conformance with IDEM's *Spatial Data Collection Standards* guidance found at http://www.in.gov/idem/files/spatial_data_collection_standards.pdf. A GPS unit capable of accurately measuring (laterally) to a meter or less (at a 95% confidence interval) is required. The sample locations will be marked in the field using temporary survey flags and a photograph will be taken to document the overall layout of the sampling area. During sampling, information to be documented includes: topography (e.g. flat, gently sloping SE, steeply sloping W), soil series

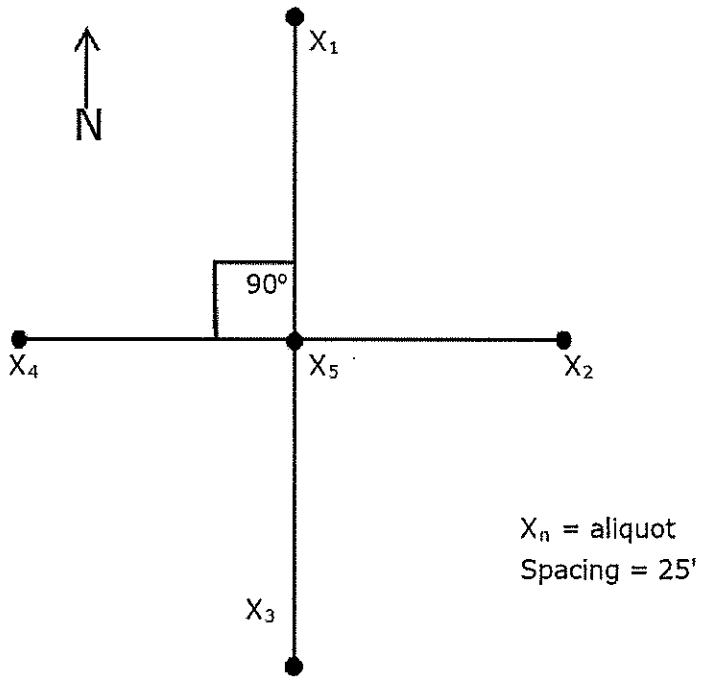
based on the available USDA soil survey map, vegetation type and density (mixed grasses, ~ 80% cover), geologic description of the material (including soil texture, color, consistency, and moisture content), weather conditions; sampling personnel identification; sample container type, size and quantity, preservation (if any); sample ID/number; and information regarding deviations from the procedures established in this SAP (e.g., south aliquot collected at 40 feet spacing due to presence of sidewalk).

2.4 Sampling Design

Sampling is tentatively planned for 50 locations within Indianapolis. These locations are tentatively designated as the "Proposed Indy Parks Background Soils Study June 2015" sent to the City on June 19, 2015. The sample locations will be evaluated for designation as either UB or MDA areas following a site visit prior to the sampling event.

2.5 Sampling Design

Surface soil (defined here as the upper 6-inches) will be collected in 5 aliquots from each sample location for compositing into a single sample for laboratory analysis. One additional composited sample will be collected and retained for future reference by IDEM technical staff. The aliquots will be collected from the intersection and the four ends of two centered 50 foot vectors oriented at a 90 degree axis for a five point composite (see diagram on next page). The vectors will generally be oriented N-S and E-W at a 90-3 degree axis (right angle) with all sample points spaced 25 feet apart. The directional orientation, vector angle, and vector length may be slightly adjusted to accommodate site obstructions and distance limitations (e.g. 10 feet minimum from parking areas). However such deviations should be avoided as much as possible as this configuration is intended to minimize bias in the sample aliquot locations. Any/all deviations should be documented in the field sheets.



2.6 Sampling Procedure

Once the sampling locations and the aliquot sampling locations are identified, a bucket auger or similar soil sampler will be advanced to collect the sample. At each aliquot location, a uniform amount of soil will be collected to a depth of 6-inches. Roots, grass, pebbles and vegetative litter should be removed from the sample before placing aliquots in a mixing bowl. The soils will be placed in the stainless steel bowl and described (refer to Section 2.3). The same procedure should be followed at the other aliquot locations, and a similar volume of soil should be collected at each aliquot location. The aliquots should then be thoroughly mixed in the stainless steel mixing bowl. The quartering technique should be used for mixing, which includes breaking the sample into four quarters, then mixing each of the quarters individually, then mixing the halves together, and finally mixing all quarters together. Once the soils are homogenized to the extent possible in the field, one 4-ounce jar (unless otherwise specified) with Teflon-lined lid should be filled with soil. One zip lock plastic bag should be filled with a similar volume for later visual manual classification. Five 6-inch cores should provide sufficient volume – if not, retrieve an additional core from each sample location for homogenization. Information listed in Section 2.3 above should be documented for each aliquot. The samples for analytical evaluation will be labeled and placed in an iced cooler, and appropriate chain-of-custody documentation will be completed. The samples for visual manual classification will be labeled and placed in a box with no preservation. The samples designated for analytical evaluation will then be relinquished to the laboratory following appropriate chain-of-custody procedures. The laboratory will be instructed on the chain-of-custody to analyze the soil samples for the relevant COIs using the appropriate U.S. EPA SW-846 methods listed below. The laboratory will be instructed to archive remaining sample for future re-analysis, if necessary. Equipment will be decontaminated following the procedures in Section 2.2 prior to leaving the sample location.

2.7 Quality Assurance/Quality Control

A single field duplicate will be collected for every 20 composite sample locations and submitted for analysis for the same parameters. Additionally, one equipment blank will be collected for every 20 composite soil samples collected. The equipment blank will be collected by pouring laboratory-provided deionized water over the decontaminated soil sampling equipment (bucket auger and bowls) and collecting that rinse water into laboratory-provided sampling containers (with the appropriate preservative).

3.0 Sample Analysis

Soil samples will be analyzed for COIs as follows:

Constituents of Interest	**Preparation Method**	**Analytical Method**
Arsenic and Lead	SW846 3050	SW846 6010C

4.0 Data Evaluation Methods

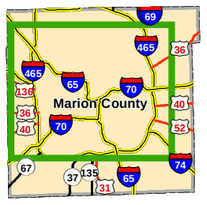
Data evaluation methods will be specified at a later date.

Background Soil Project Indiana

Indianapolis Parks Sampled
Marion County, Indiana

Riverwood Park
Stamm Park
Juan Solomon Park
Broadway & 61st Street (Dan Wakefield) Park
Canterbury Park
Arsenal Park
Elwood & Mary Black Park
Andrew Ramsey Park
Tarkington Park
Gateway West Park
Faculty Park
Moreland Park
Bertha Ross Park
Watson Road Bird Preserve
Beckwith Memorial Park
Washington Park
Al E. Polin Park
Oscar Charleston Park
Douglass Park
Dr. Martin Luther King Jr. Park
JTV Hill Park
John Ed Park
Centennial & Groff Park
Frank & Judy O'Bannon Soccer Field
Denver Park
Haughville Park
Olin Park
Lentz Park
Highland Park
Max Bahr Park
Stringtown Park
Thatcher Park
Hawthorne Park
Willard Park
Indianola Park
McCarty Triangle Park
Edna Balz Lacy Park
Porter Playfield
Christina Oaks Park
Rhodius Park
Kelly Park
Orange Park
Ross Claypool Park
Bethel Park
Garfield Park
Stout Field Park
Bluff Park
Gardner Park
Roselawn Park
Doris Cowherd Park
Wes Montgomery Park
Windsor Village Park
Virginia Lee O'Brien Park
Ellenberger Park

Indianapolis Park



0 0.5 1 2 Miles
0 0.5 1 2 3 Kilometers

N W E S

IDEM

Sources:

Non Orthophotography Data
- Indianapolis Parks Data obtained from City of Indianapolis/Marion County

Orthophotography
- Obtained from World Street Map Imagery - Esri, DeLorme, HERE, USGS, Intermap, iPC, NRCAN, METI, Tomtom

Map Projection : UTM Zone 16 N
Map Datum: NAD83

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 22, 2018

Background Soil Project - Indiana
Indianapolis Parks Map Series
Marion County, Indiana

Map Index	Park Name
1	Al E. Polin Park
2	Andrew Ramsey Park
3	Arsenal Park
4	Beckwith Memorial Park
5	Bertha Ross Park
6	Bethel Park
7	Bluff Park
8	Broadway & 61st St. (Dan Wakefield) Park
9	Canterbury Park
10	Centennial & Groff Park
11	Christina Oaks Park
12	Denver Park
13	Doris Cowherd Park
14	Douglass Park
15	Dr. Martin Luther King Jr. Park
16	Edna Balz Lacy Park
17	Ellenberger Park #1
18	Ellenberger Park #2
19	Elwood & Mary Black Park
20	Faculty Park
21	Frank & Judy O'Bannon Soccer Field
22	Gardner Park
23	Garfield Park #1
24	Garfield Park #2
25	Gateway West Park
26	Haughville Park
27	Hawthorne Park
28	Highland Park

Map Index	Park Name
29	Indianola Park
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36	McCarty Triangle Park
37	Moreland Park
38	Olin Park
39	Orange Park
40	Oscar Charleston Park
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44	Roselawn Park
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47	Stout Field Park
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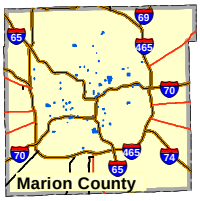
49	Tarkington Park
50	Thatcher Park
51	Virginia Lee O'Brien Park
52	Washington Park
53	Watson Road Bird Preserve
54	Wes Montgomery Park
55	Willard Park
56	Windsor Village Park

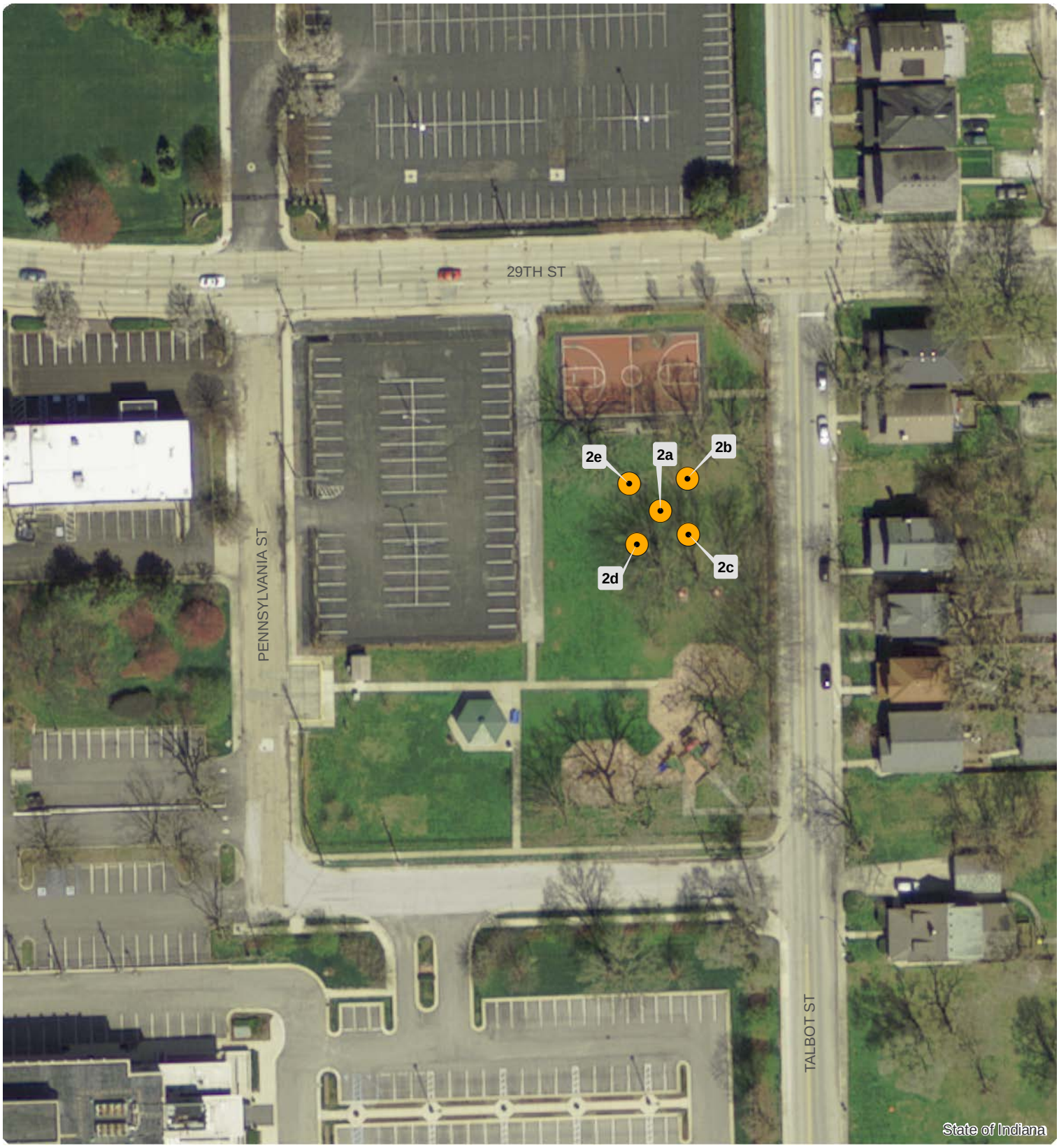


Map Series Sources:
Non Orthophotography Data
- Obtained from the State of Indiana Geographical Information Office Library
- Indianapolis Park Data obtained from City of Indianapolis/Marion County
- Sample Locations obtained from IDEM OLQ

Sampling Database (SampDB)
Orthophotography - Orthophotography of Indiana (2017) State of Indiana, Indiana Office of Information Technology, Indiana University Spatial Data Portal, UITS, Woolpert Inc.
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

IDEM

Al E. Polin Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 23, 2018

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0 25 50 100 Feet
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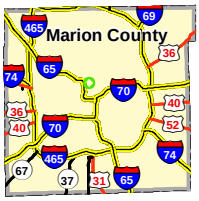

MAP 1

Andrew Ramsey Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

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Office of Land Quality
Date: May 17, 2018

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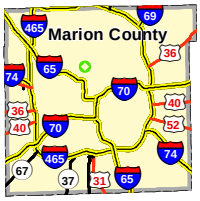

MAP 2

Arsenal Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 14, 2018

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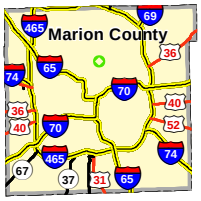
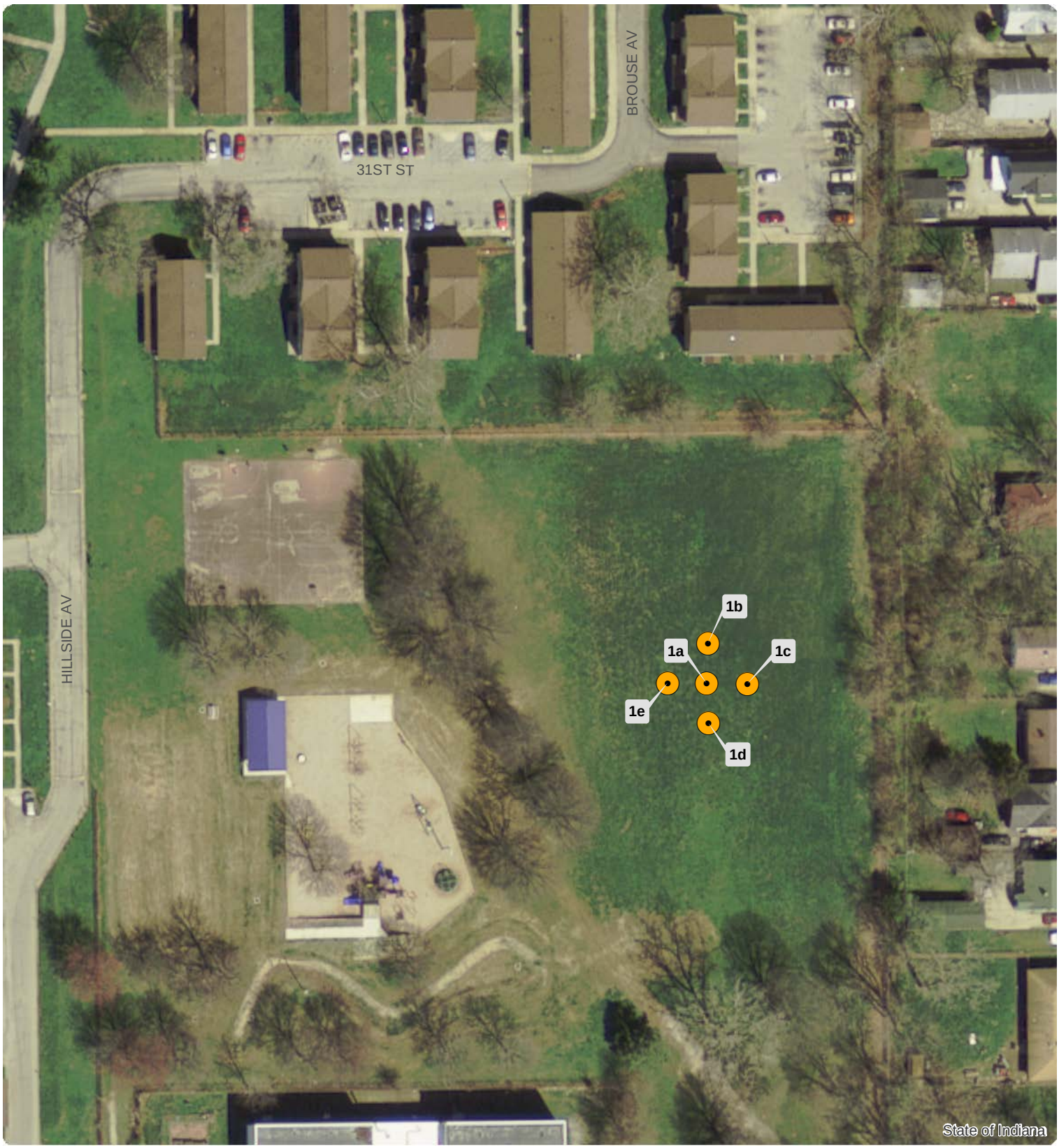


MAP 3

Beckwith Memorial Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 14, 2018

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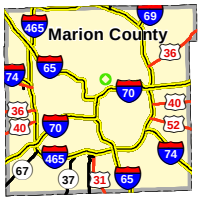
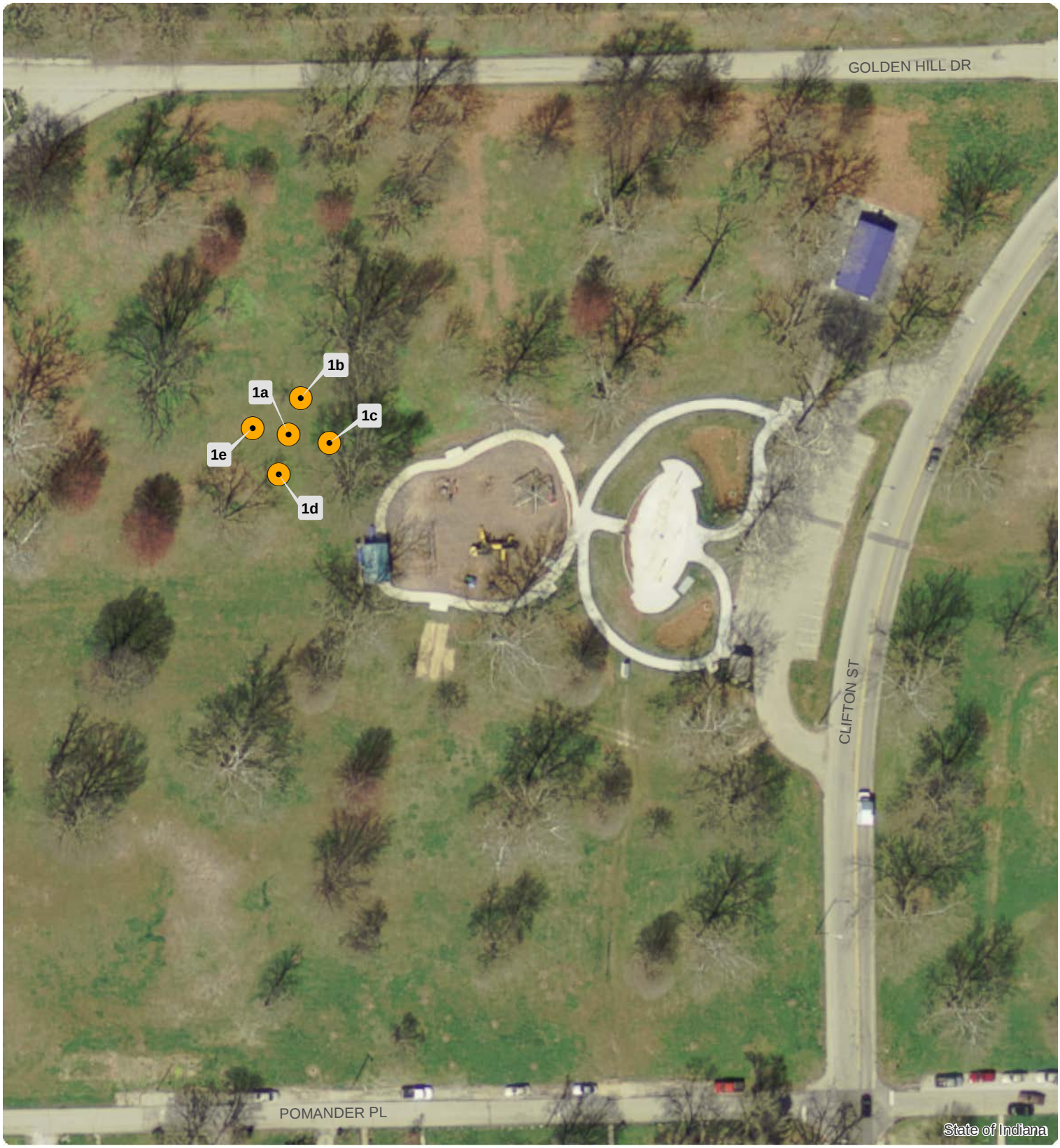
IDEM

0 25 50 100 Feet
0 7.5 15 30 Meters



MAP 4

Bertha Ross Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 14, 2018

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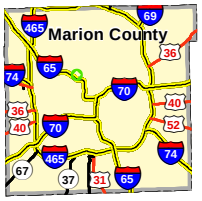
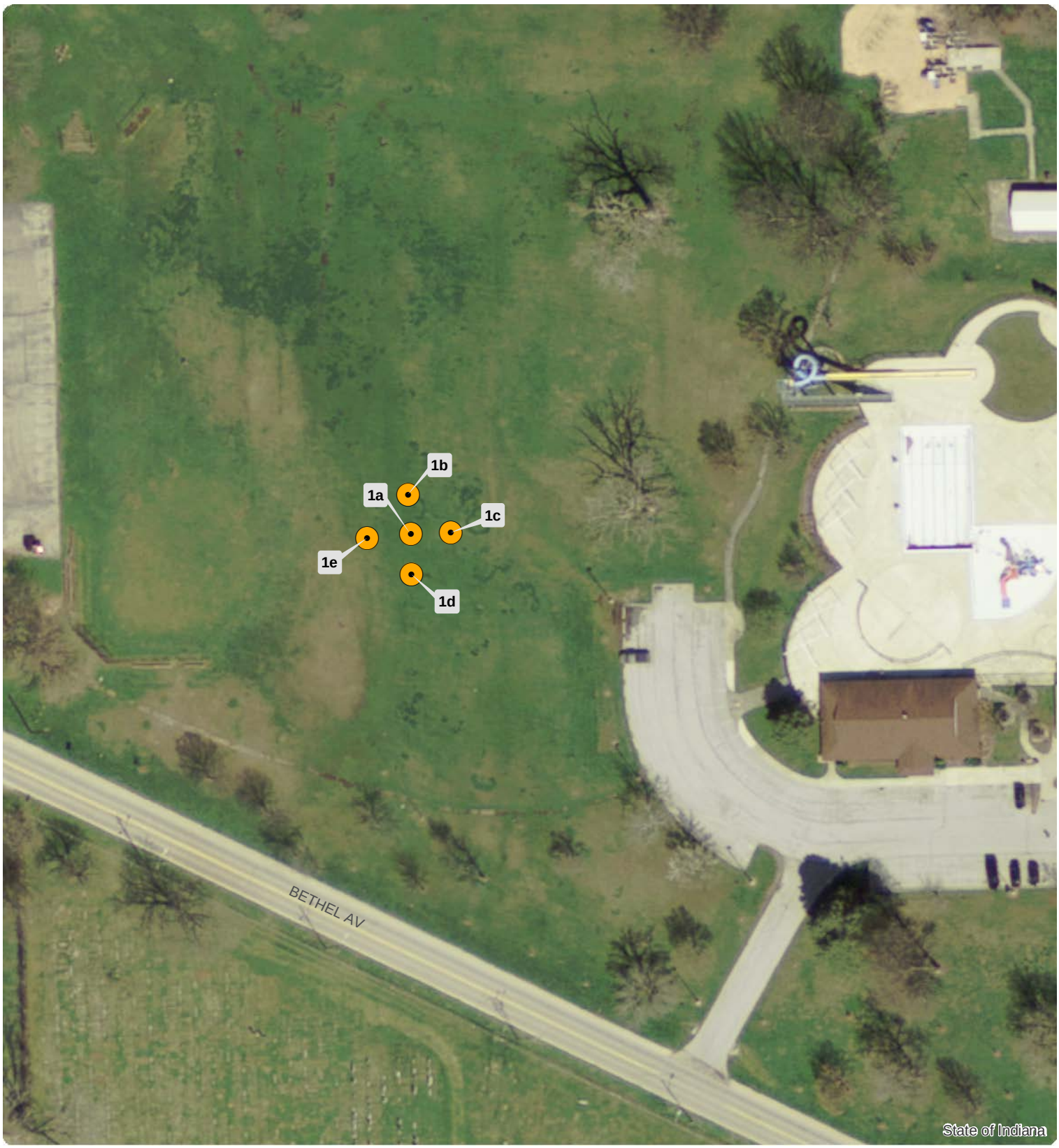


MAP 5

Bethel Park



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 14, 2018

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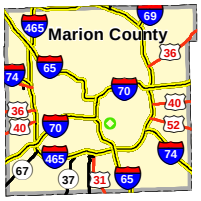
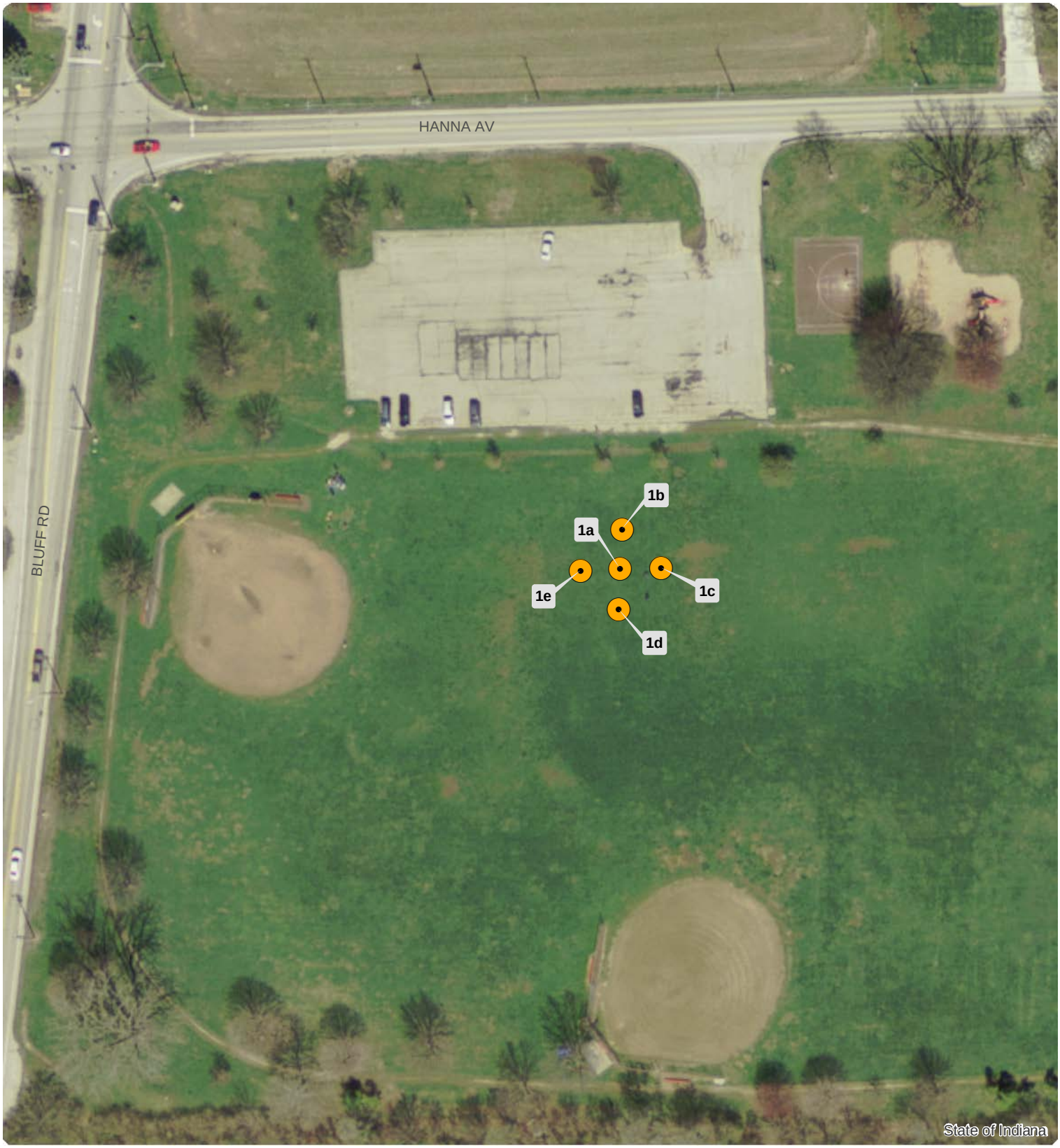


MAP 6

Bluff Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 15, 2018

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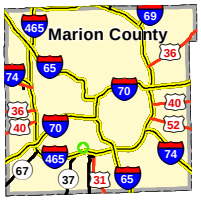
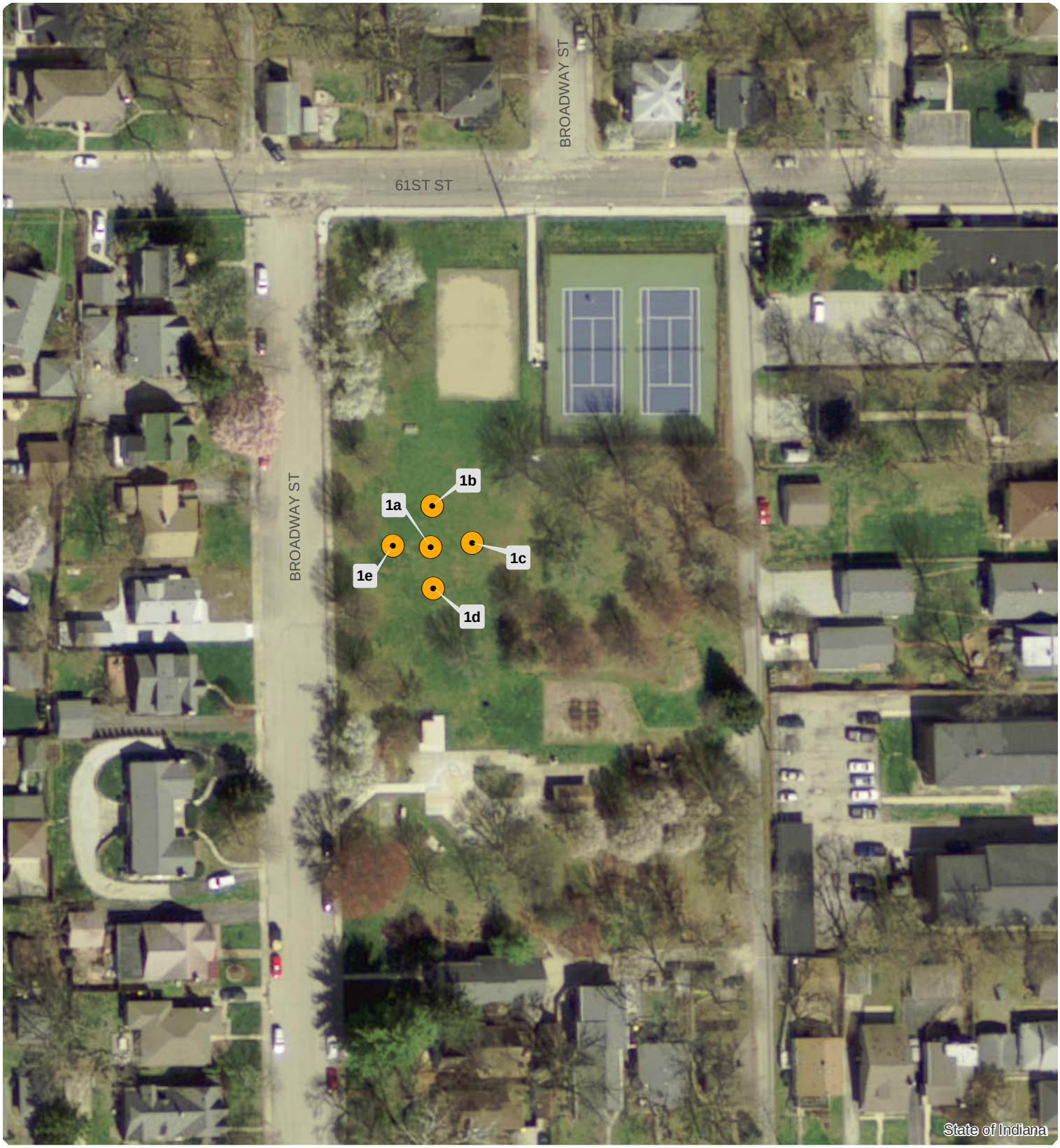


MAP 7

Broadway & 61st St. (Dan Wakefield) Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 15, 2018

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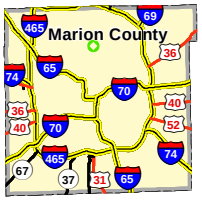

MAP 8

Canterbury Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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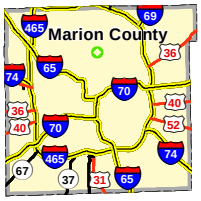

MAP 9

Centennial & Groff Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 16, 2018

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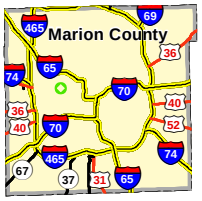

MAP 10

Christina Oaks Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 16, 2018

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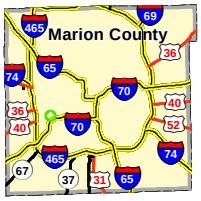
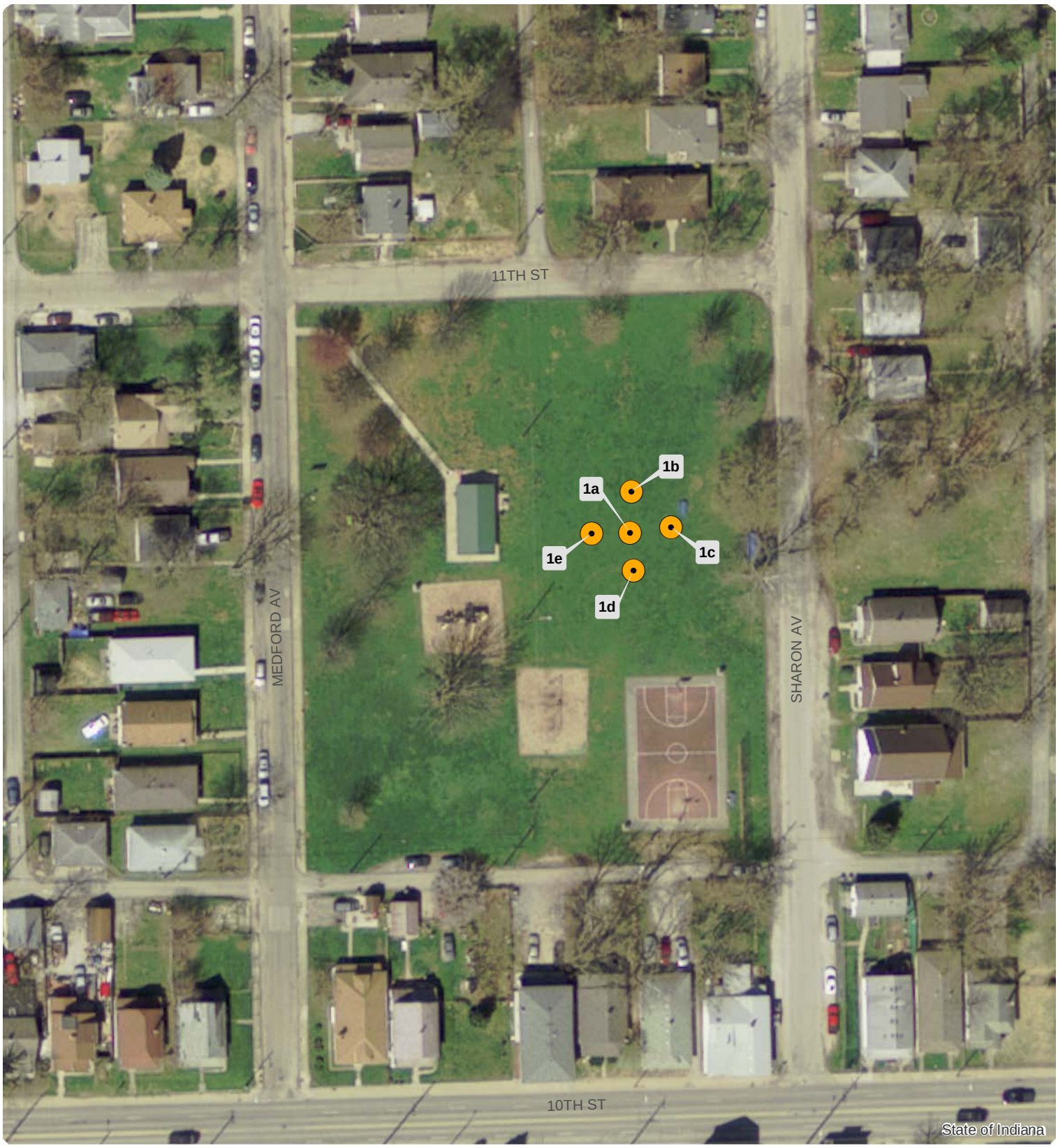


MAP 11

Denver Park



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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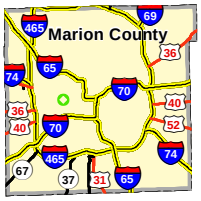

MAP 12

Doris Cowherd Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 16, 2018

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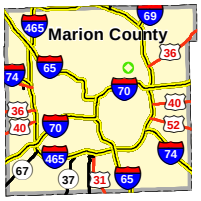

MAP 13

Douglass Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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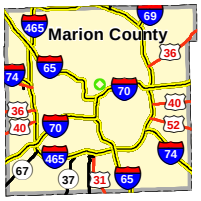
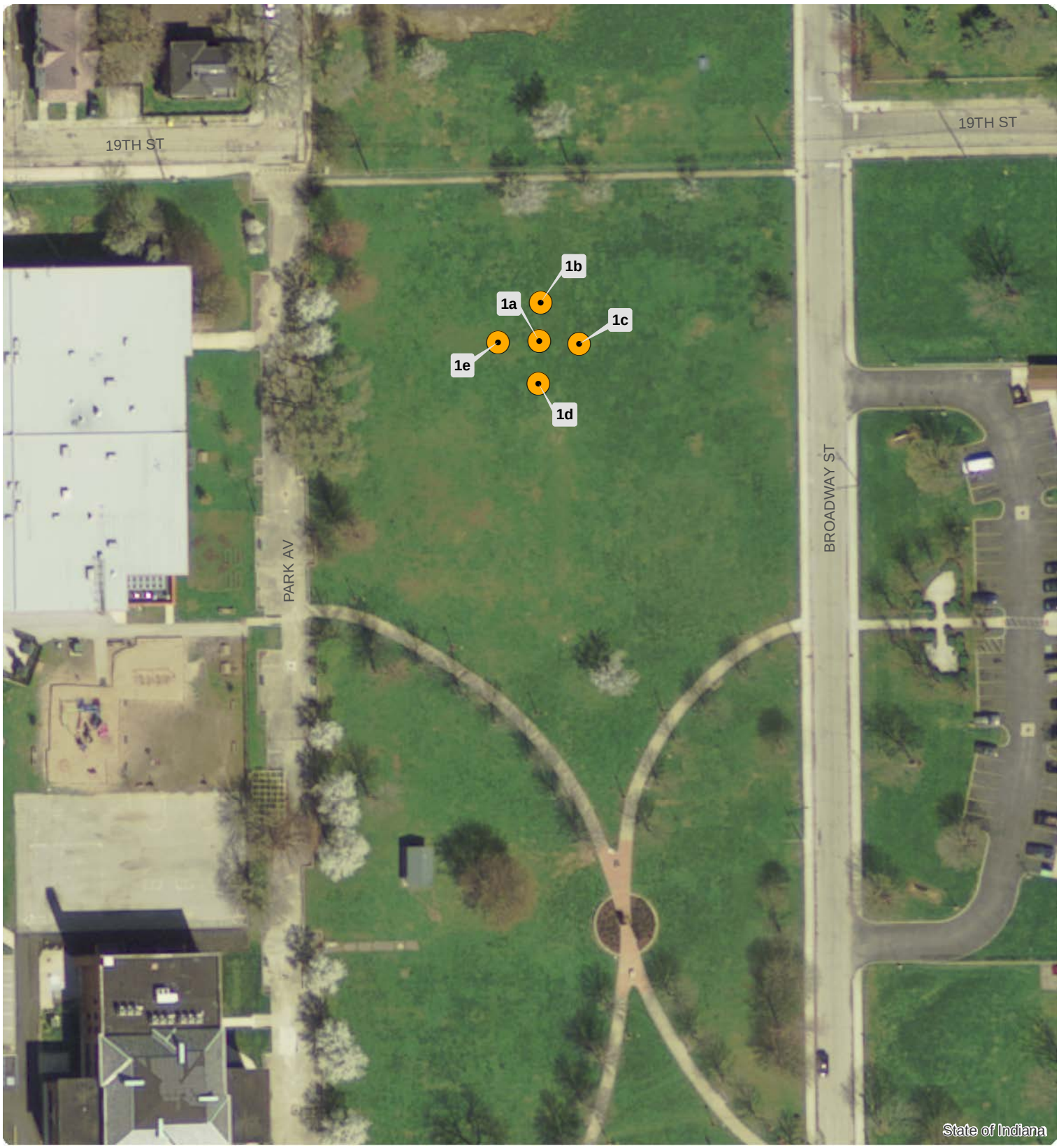


MAP 14

Dr. Martin Luther King Jr. Park



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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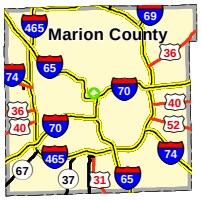

MAP 15

Edna Balz Lacy Park

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Mapped By: Cyndi Jones
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Date: May 16, 2018

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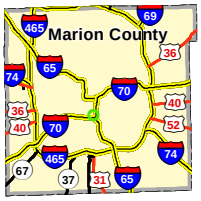

MAP 16

Ellenberger Park #1

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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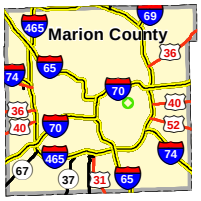

MAP 17

Ellenberger Park #2

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 16, 2018

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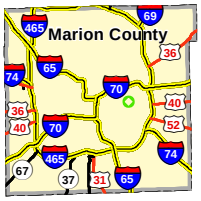

MAP 18

Elwood & Mary Black Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 16, 2018

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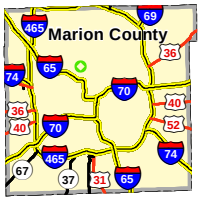

MAP 19

Faculty Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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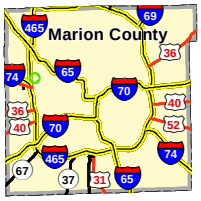
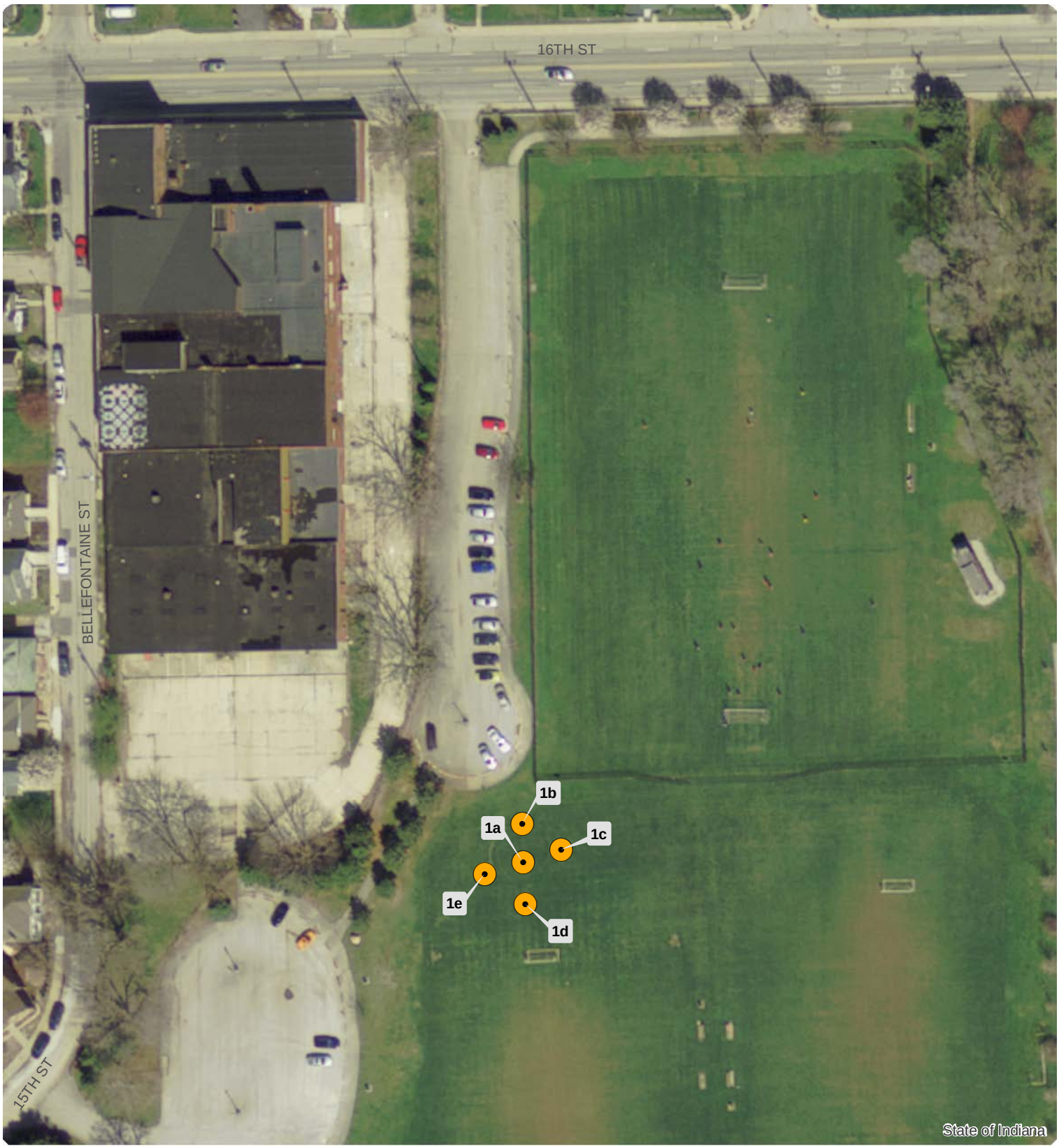


MAP 20

Frank & Judy O'Bannon Soccer Field



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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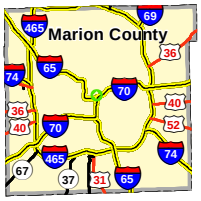

MAP 21

Gardner Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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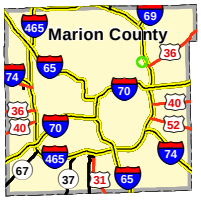

MAP 22

Garfield Park #1

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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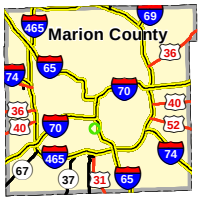
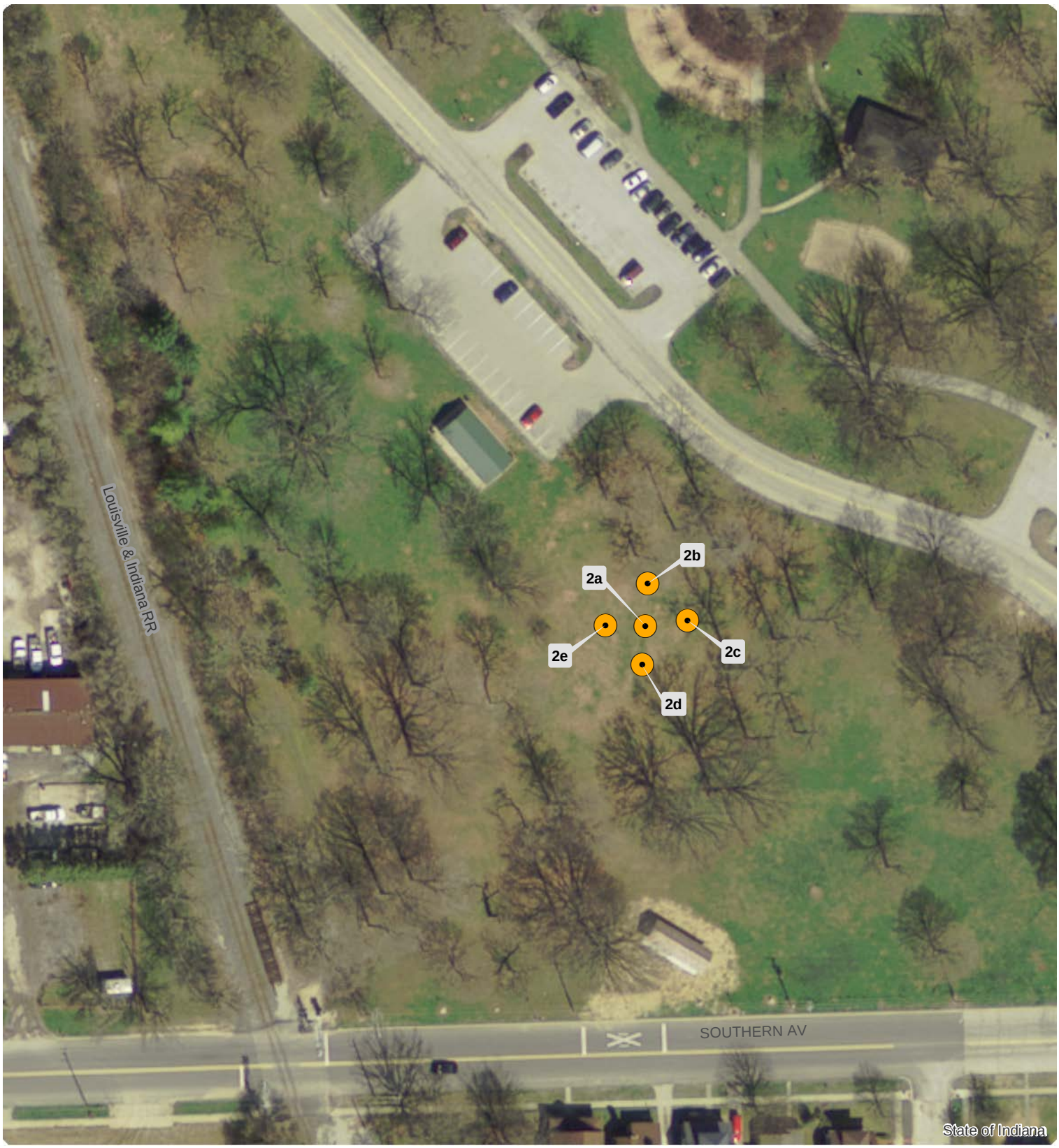


MAP 23

Garfield Park #2



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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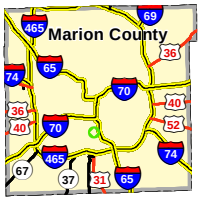

MAP 24

Gateway West Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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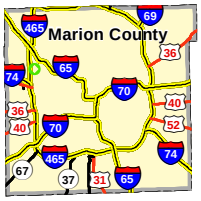
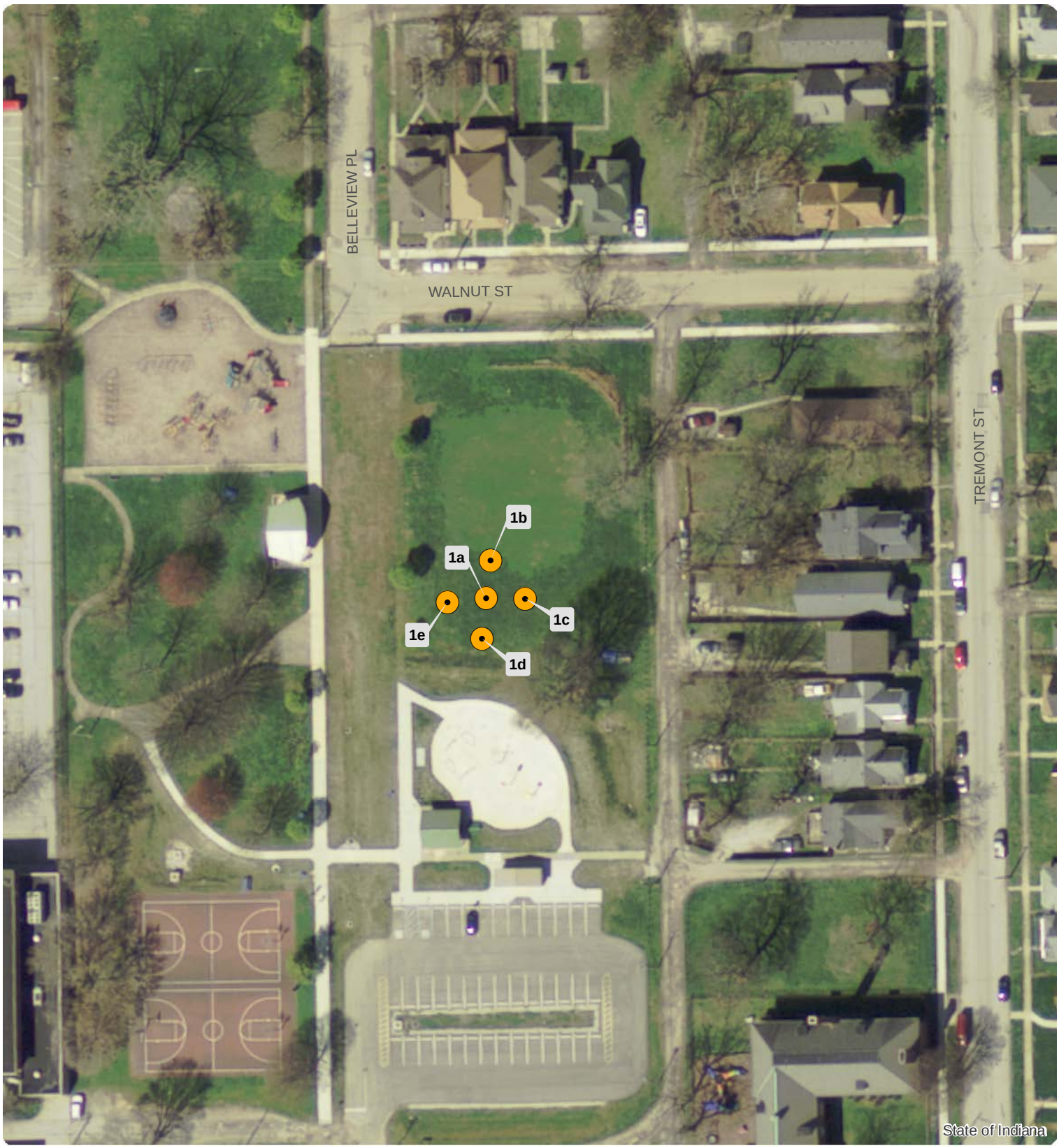


MAP 25

Haughville Park



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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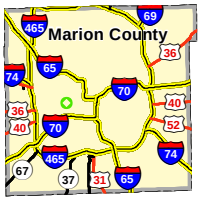

MAP 26

Hawthorne Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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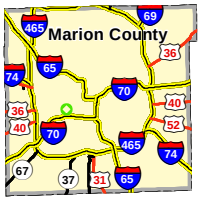

MAP 27

Highland Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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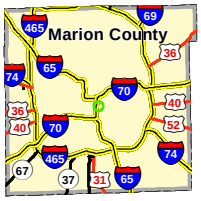

MAP 28

Indianola Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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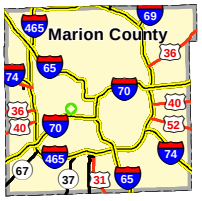

MAP 29

John Ed Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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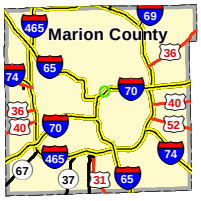

MAP 30

JTV Hill Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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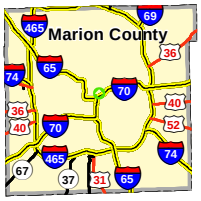
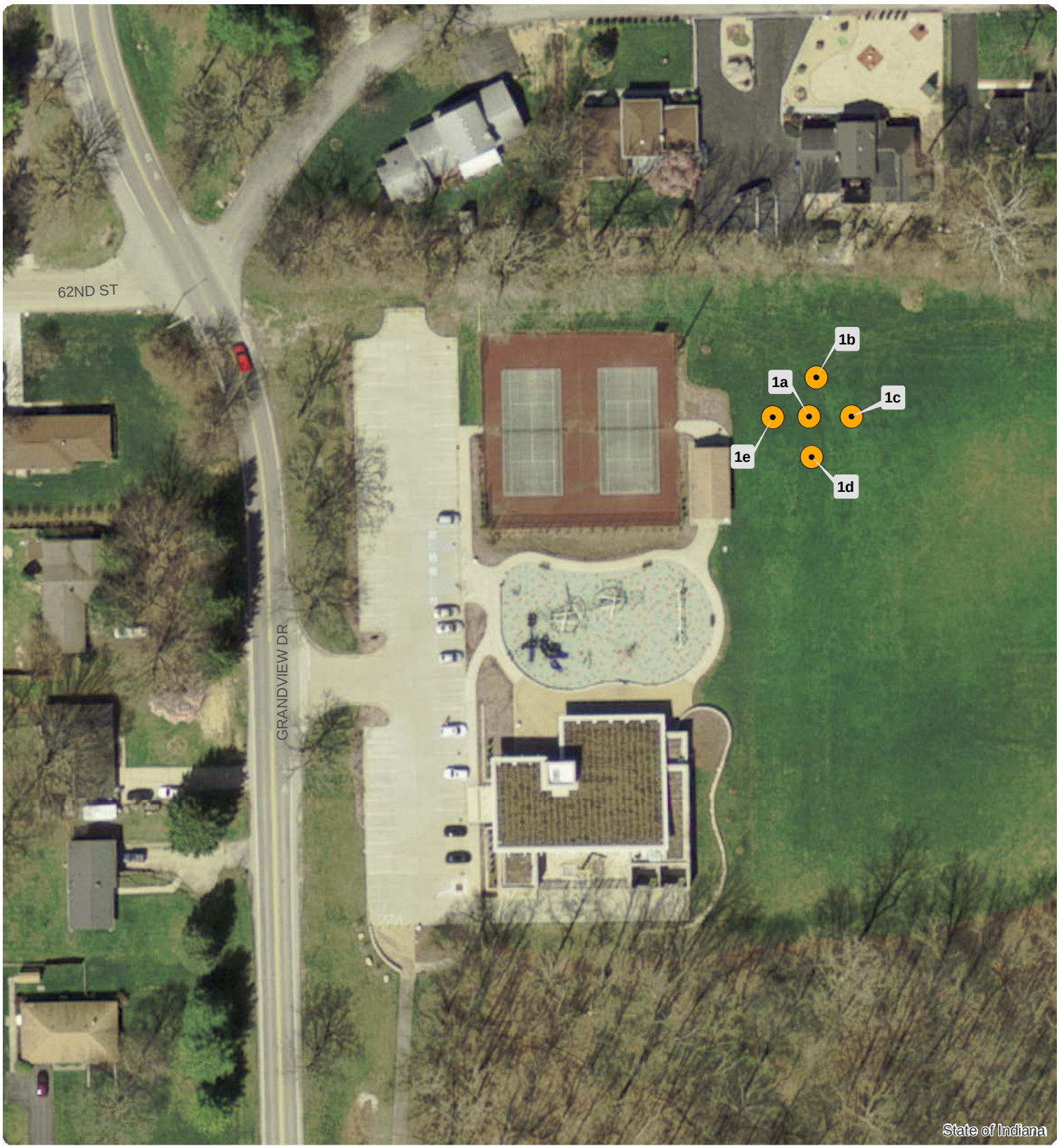


MAP 31

Juan Solomon Park



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Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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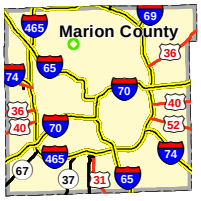
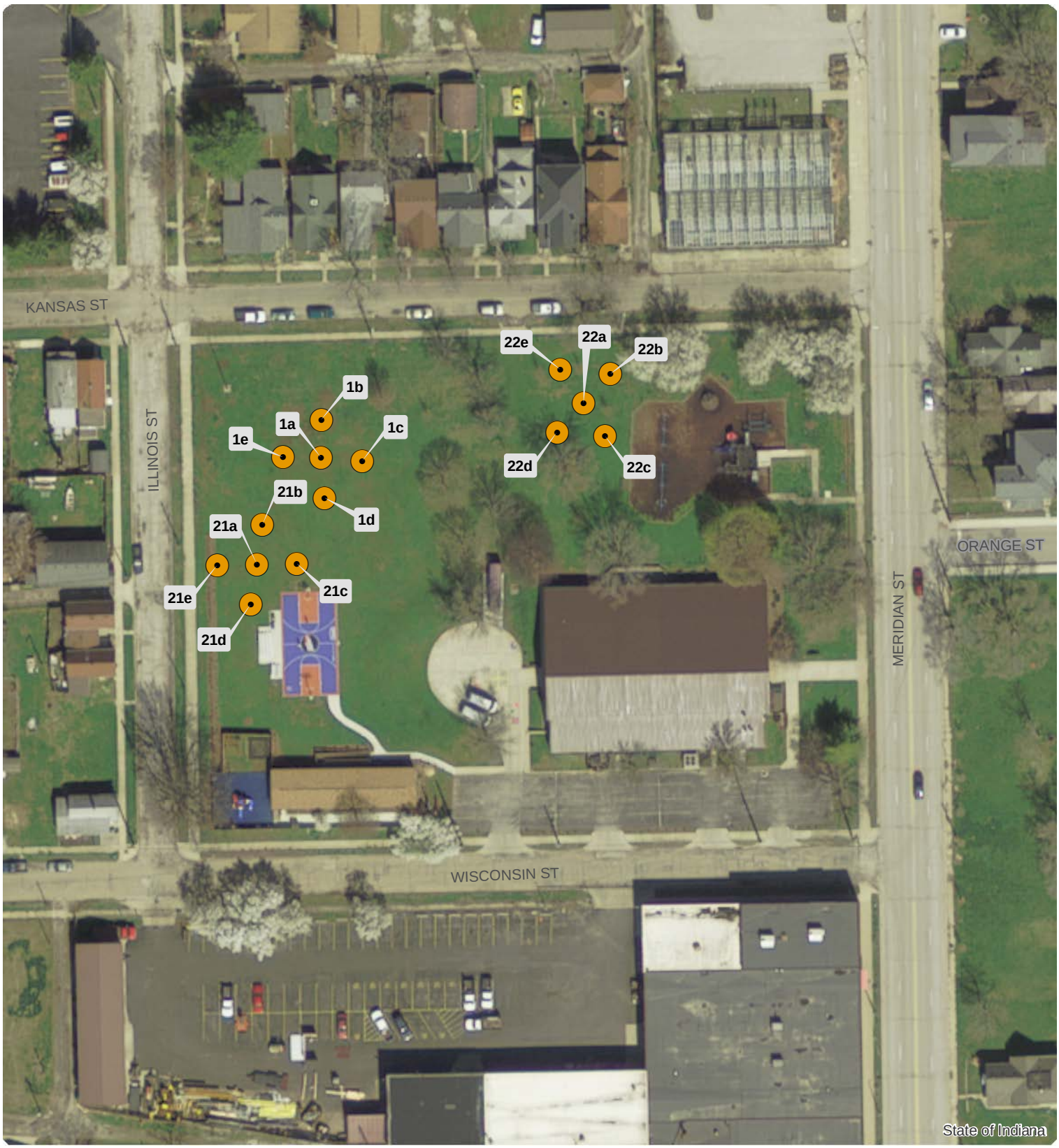


MAP 32

Kelly Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 22, 2018

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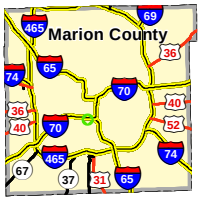

MAP 33

Lentz Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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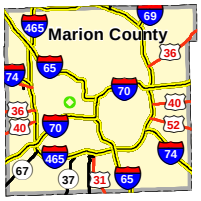
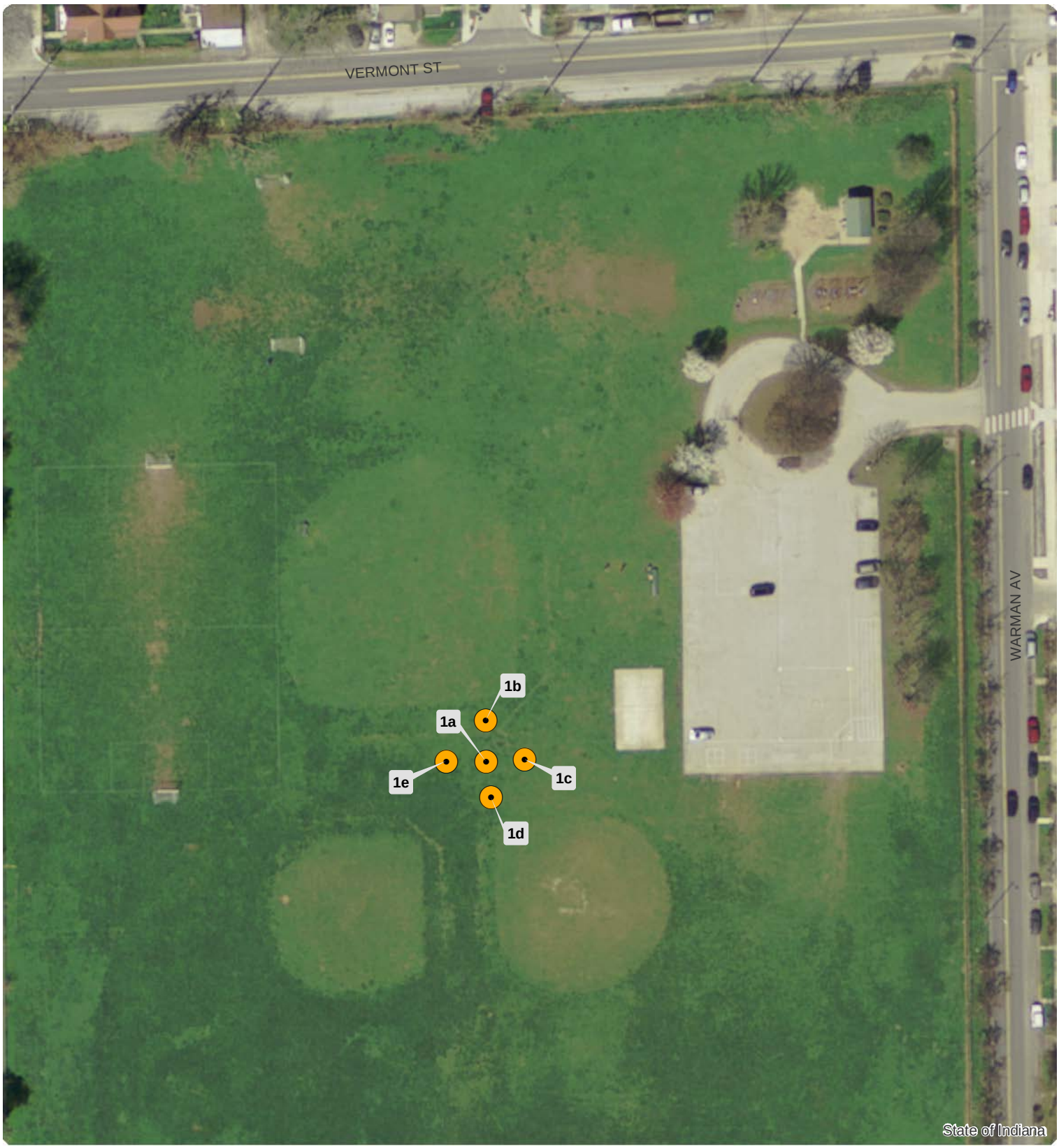


MAP 34

Max Bahr Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 17, 2018

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0 25 50 100 Feet
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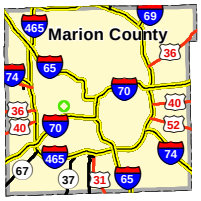

MAP 35

McCarty Triangle Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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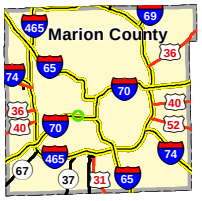
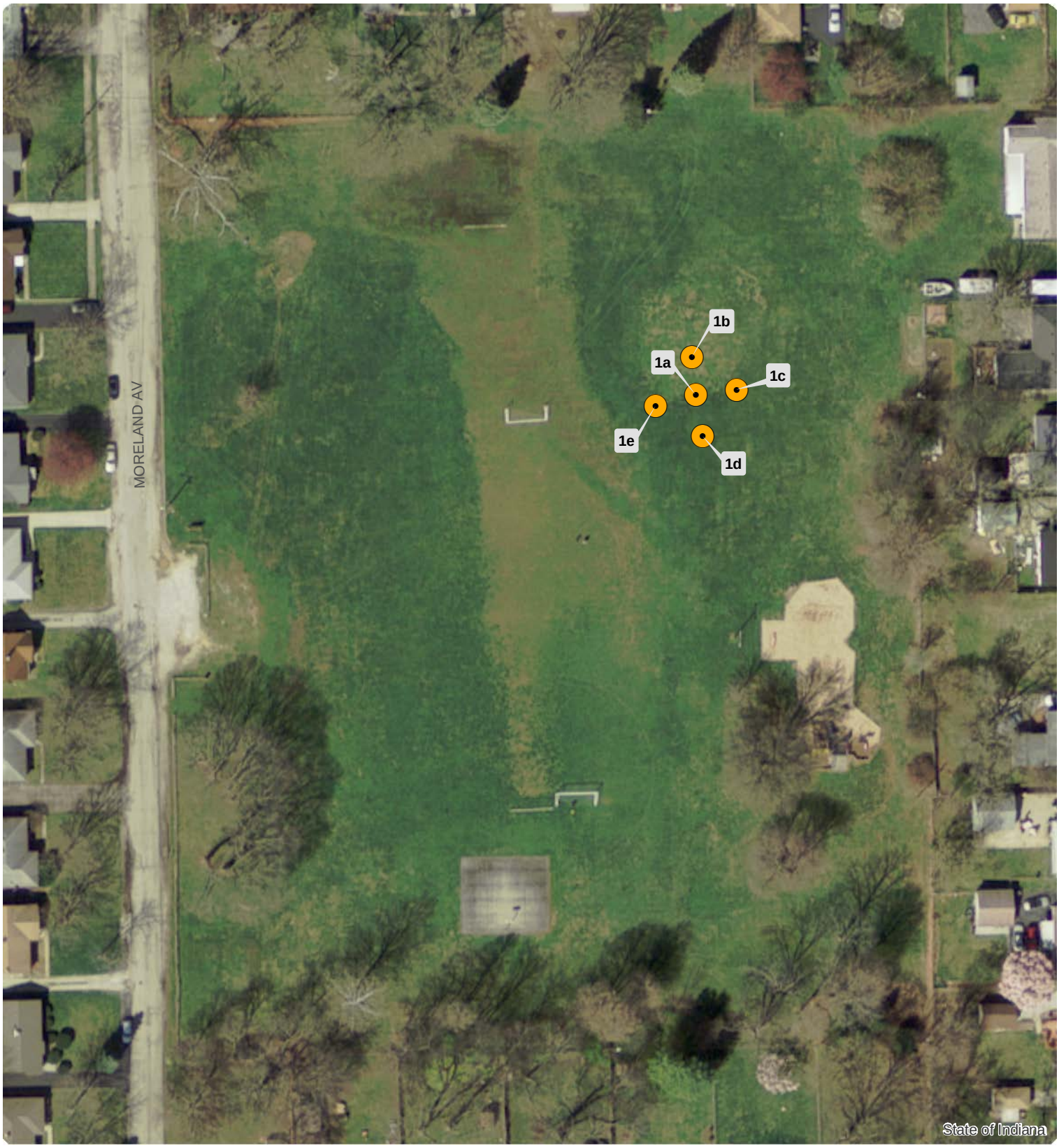


MAP 36

Moreland Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 18, 2018

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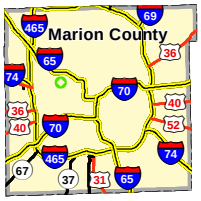

MAP 37

Olin Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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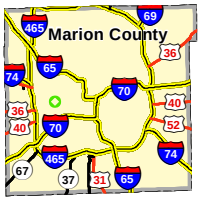

MAP 38

Orange Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 18, 2018

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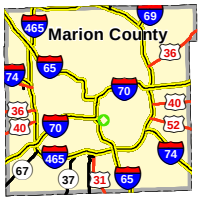
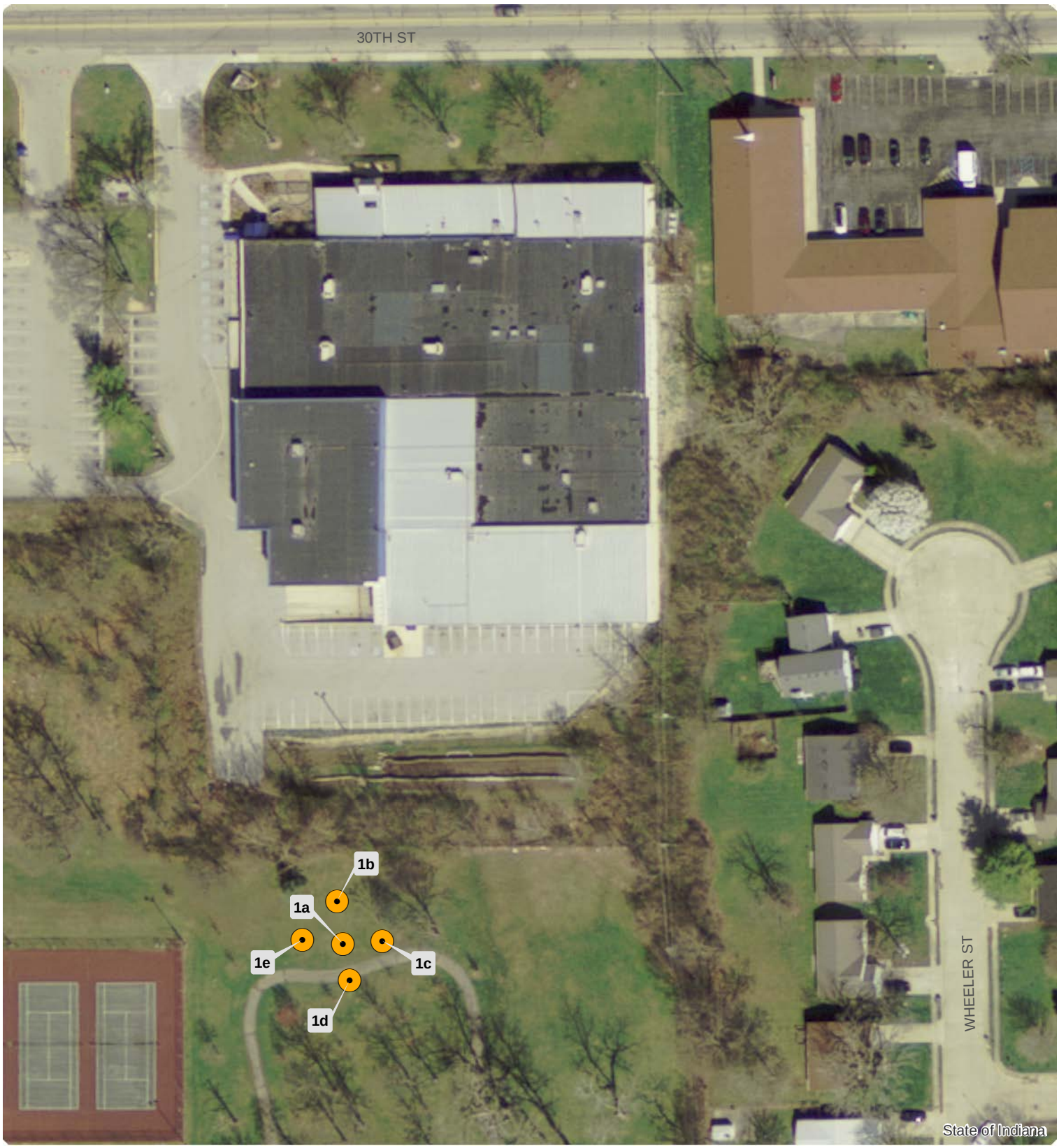


MAP 39

Oscar Charleston Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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0 25 50 100 Feet
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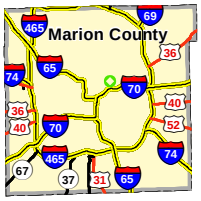

MAP 40

Porter Playfield

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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0 25 50 100 Feet
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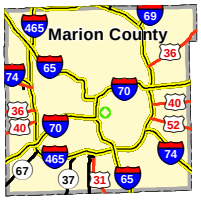
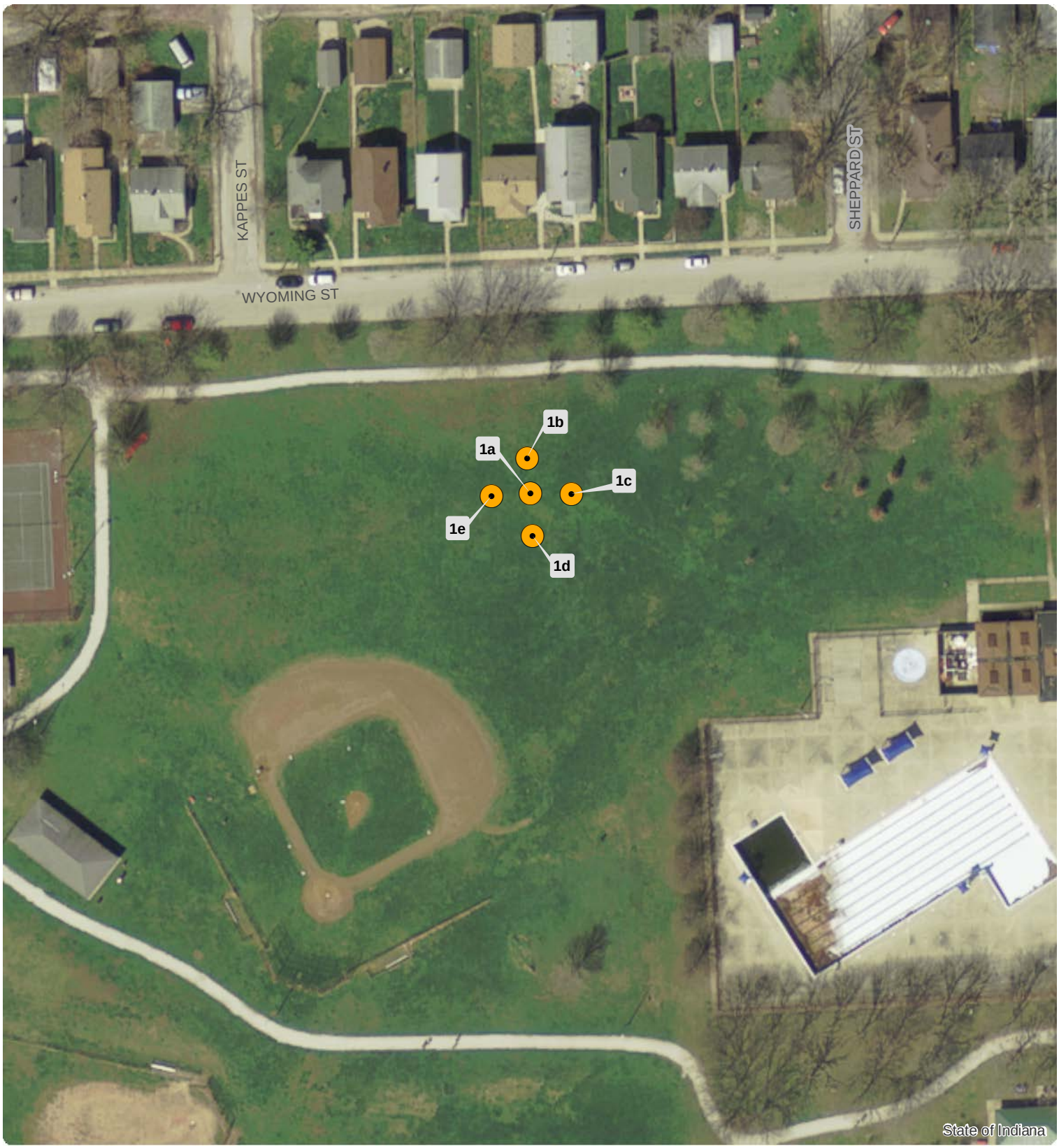


MAP 41

Rhodius Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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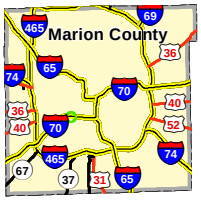

MAP 42

Riverwood Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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0 25 50 100 Feet
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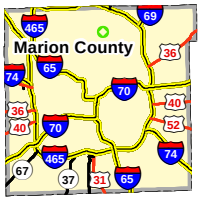

MAP 43

Roselawn Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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0 25 50 100 Feet
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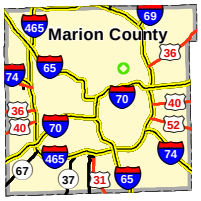

MAP 44

Ross Claypool Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 18, 2018

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0 25 50 100 Feet
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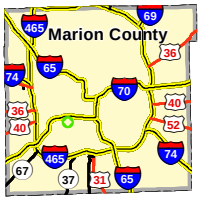
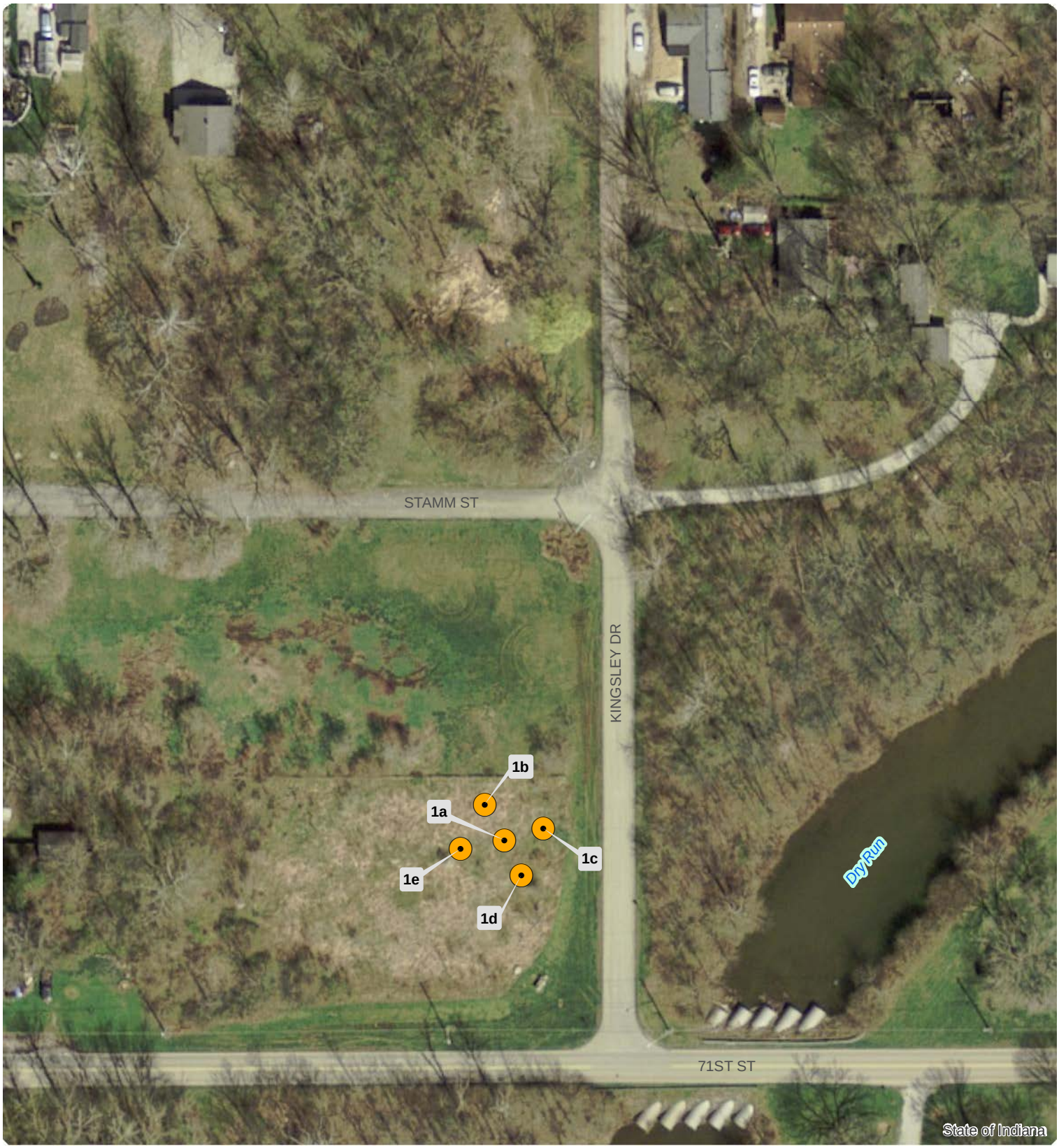


MAP 45

Stamm Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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0 25 50 100 Feet
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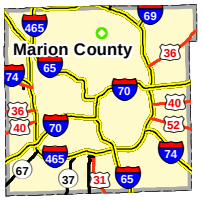
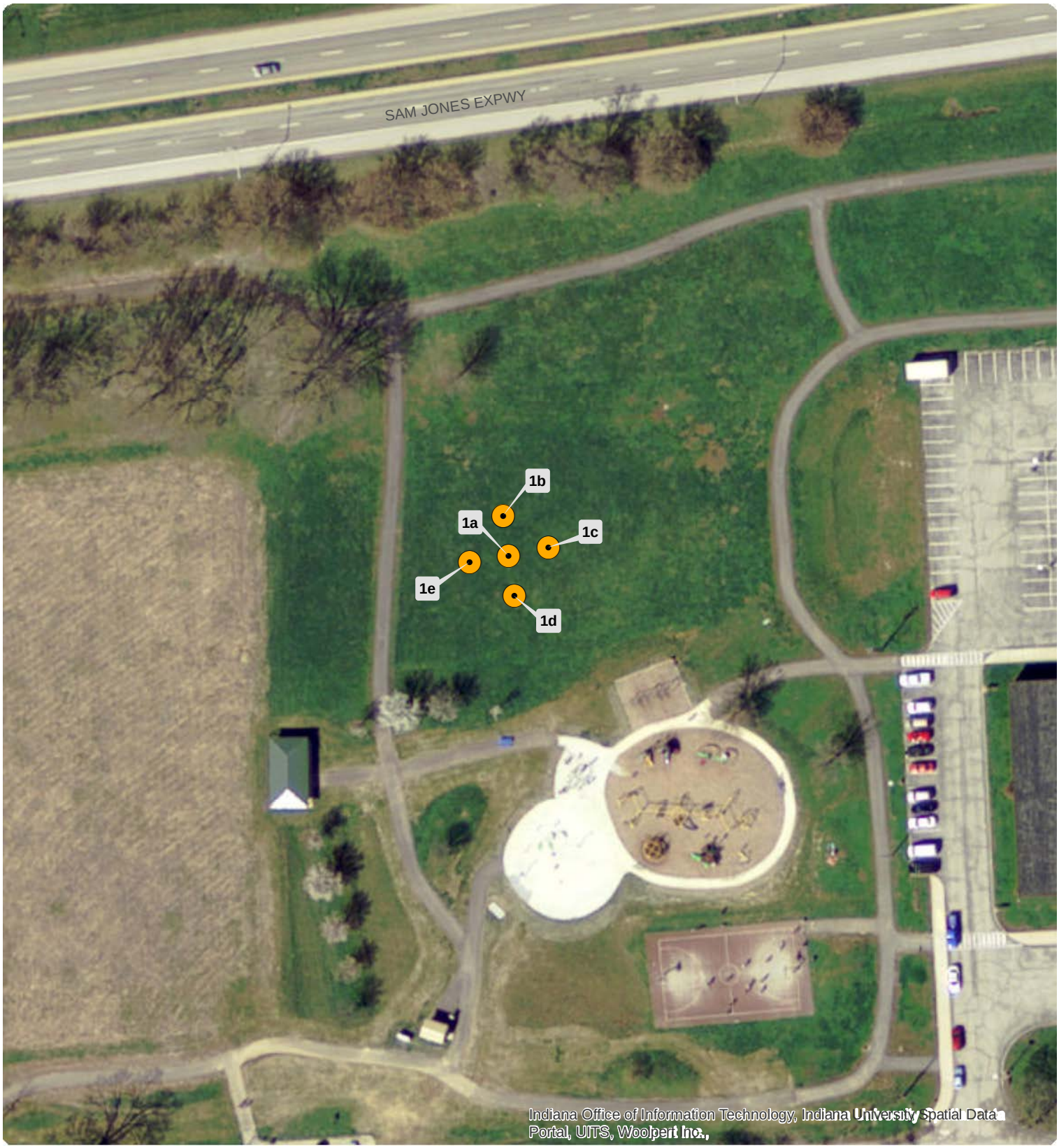


MAP 46

Stout Field Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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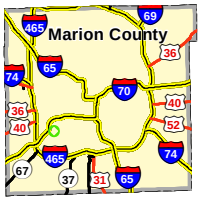

MAP 47

Stringtown Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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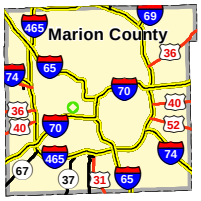
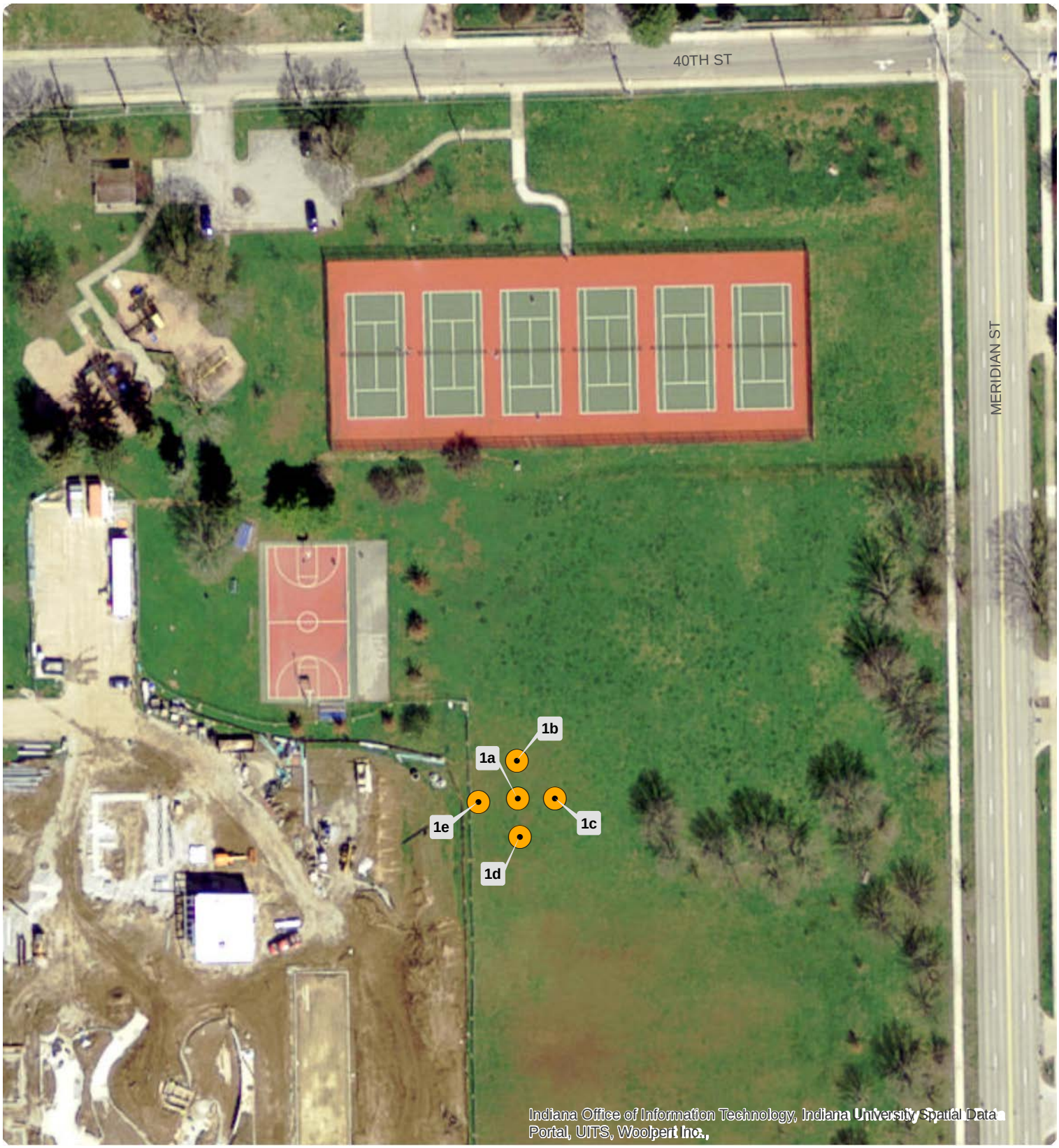


MAP 48

Tarkington Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
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Date: May 21, 2018

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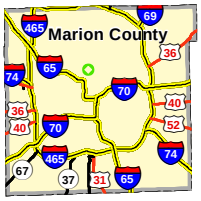
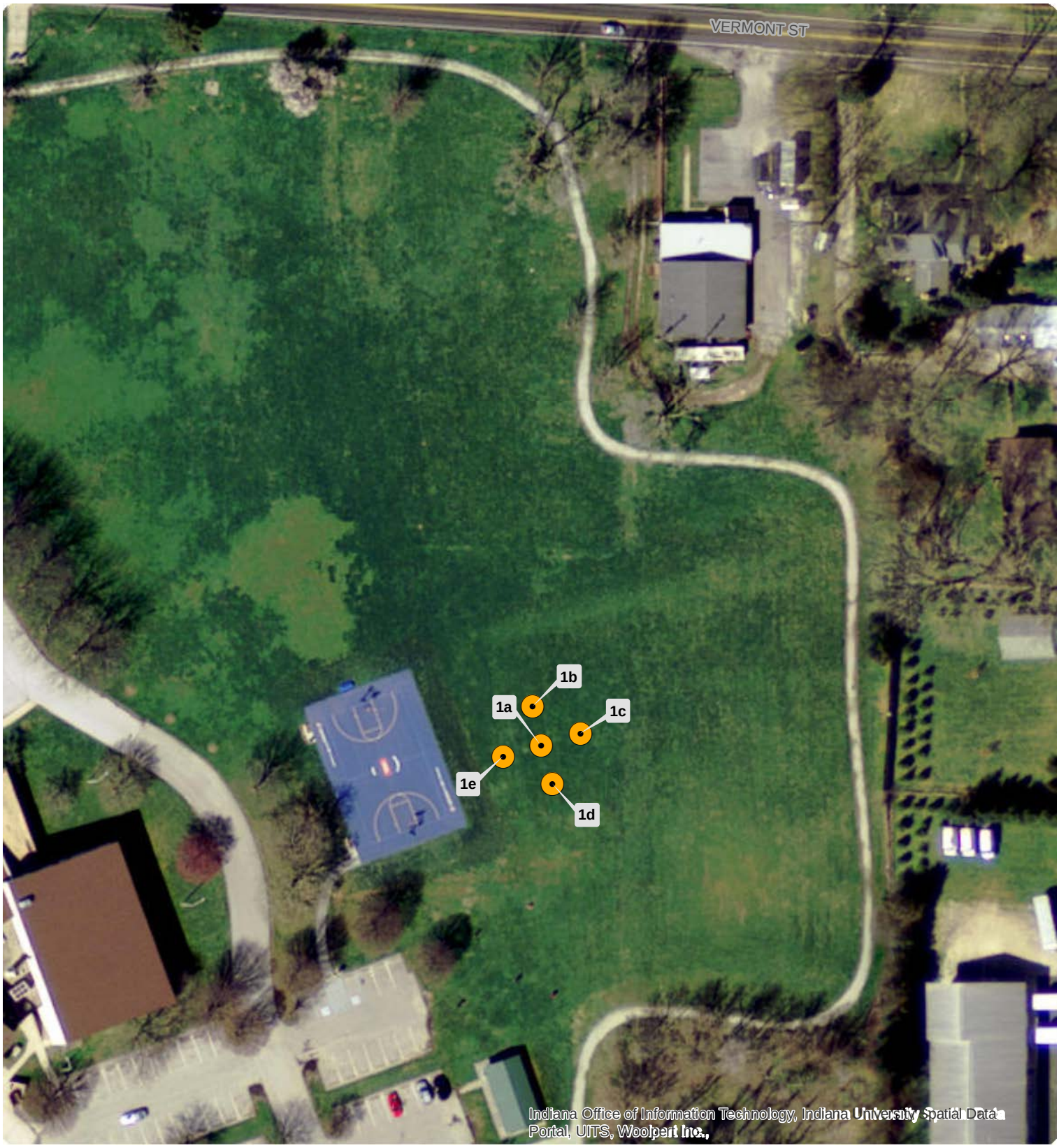


MAP 49

Thatcher Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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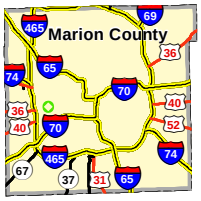
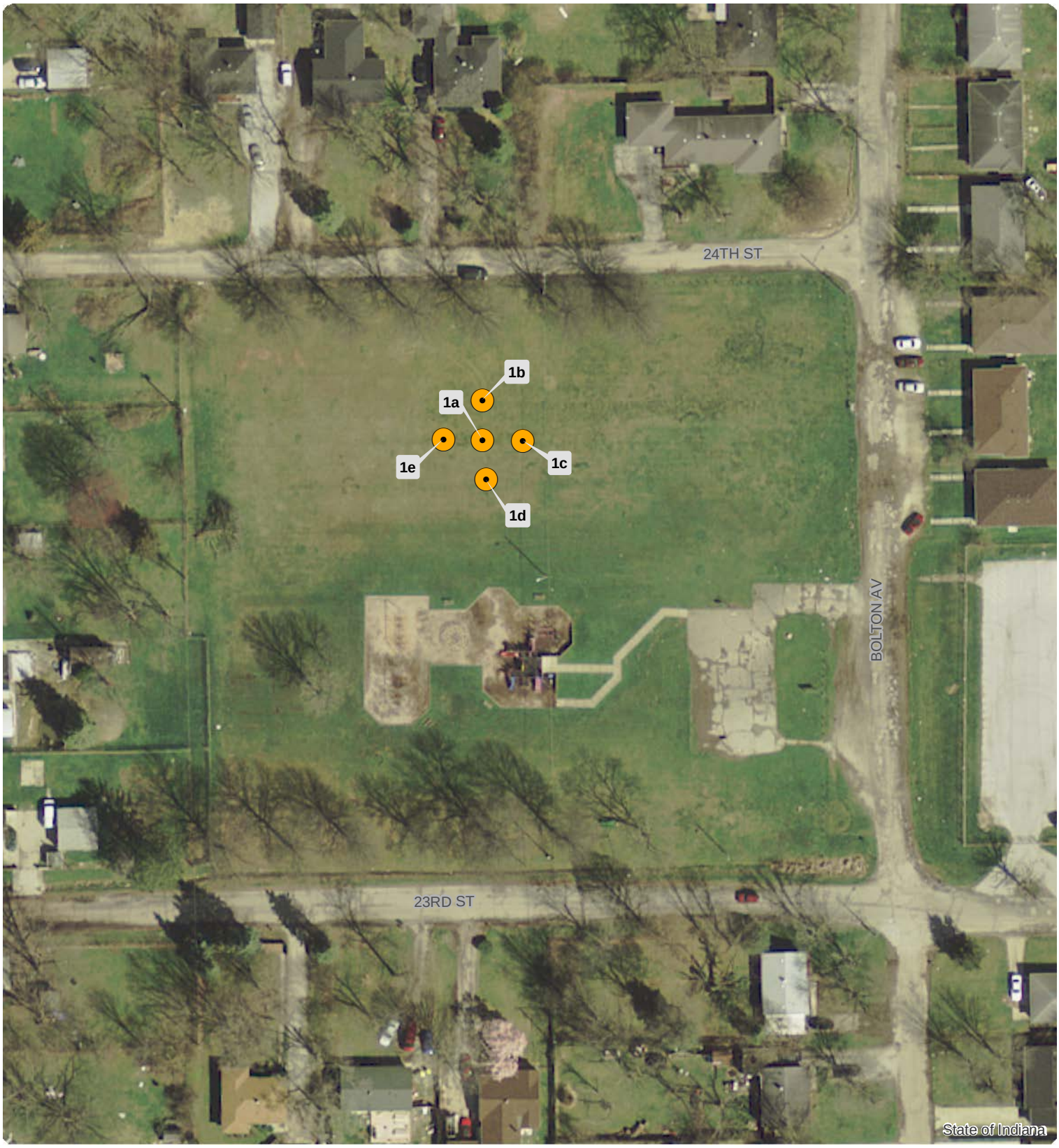


MAP 50

Virginia Lee O'Brien Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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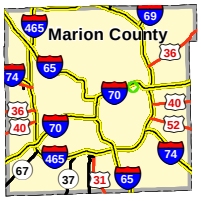

MAP 51

Washington Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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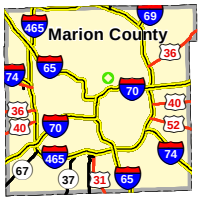

MAP 52

Watson Road Bird Preserve

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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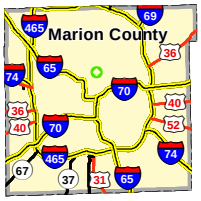
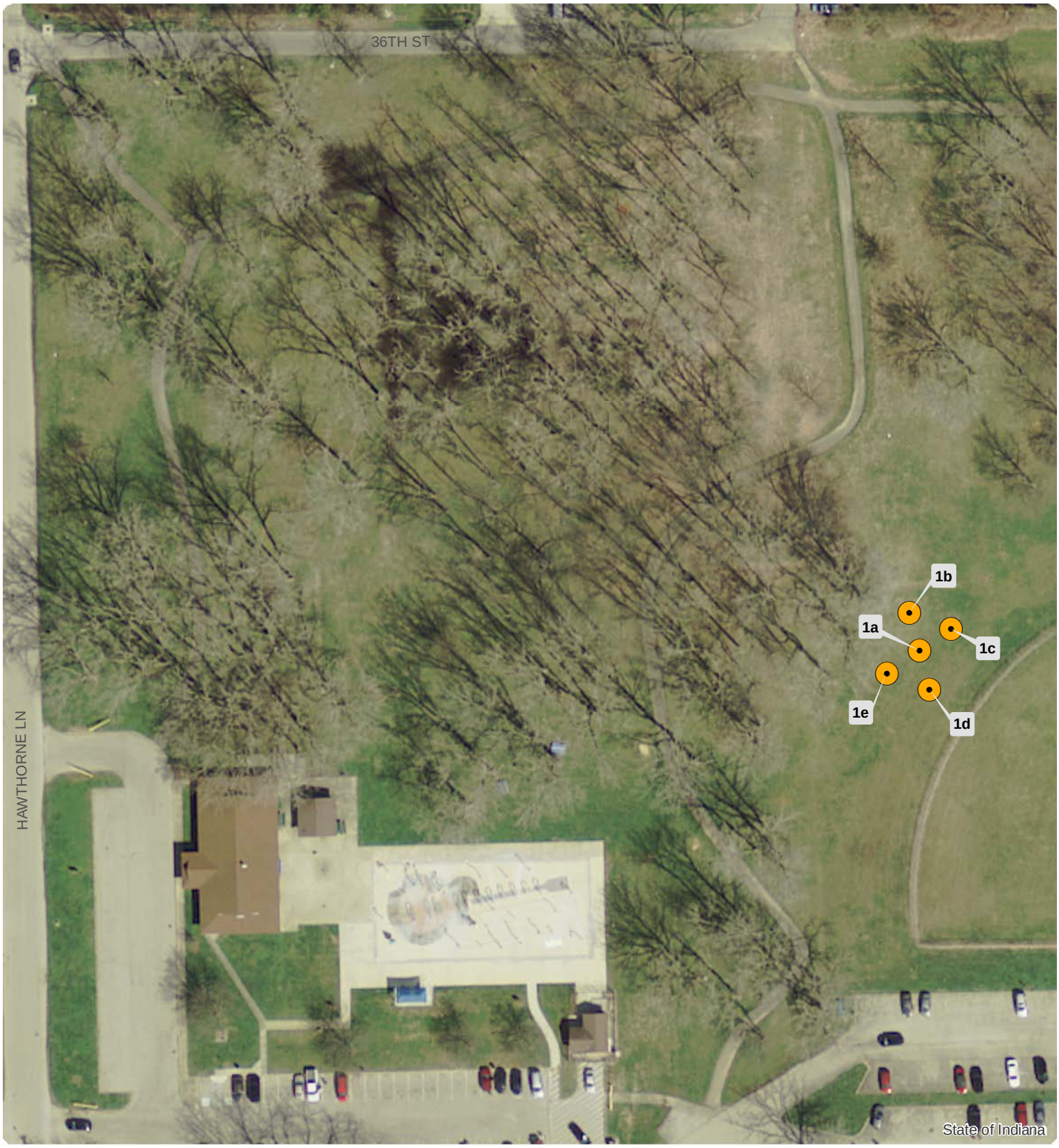


MAP 53

Wes Montgomery Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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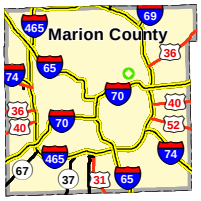

MAP 54

Willard Park

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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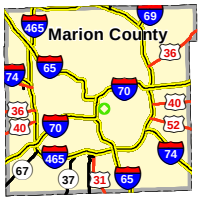
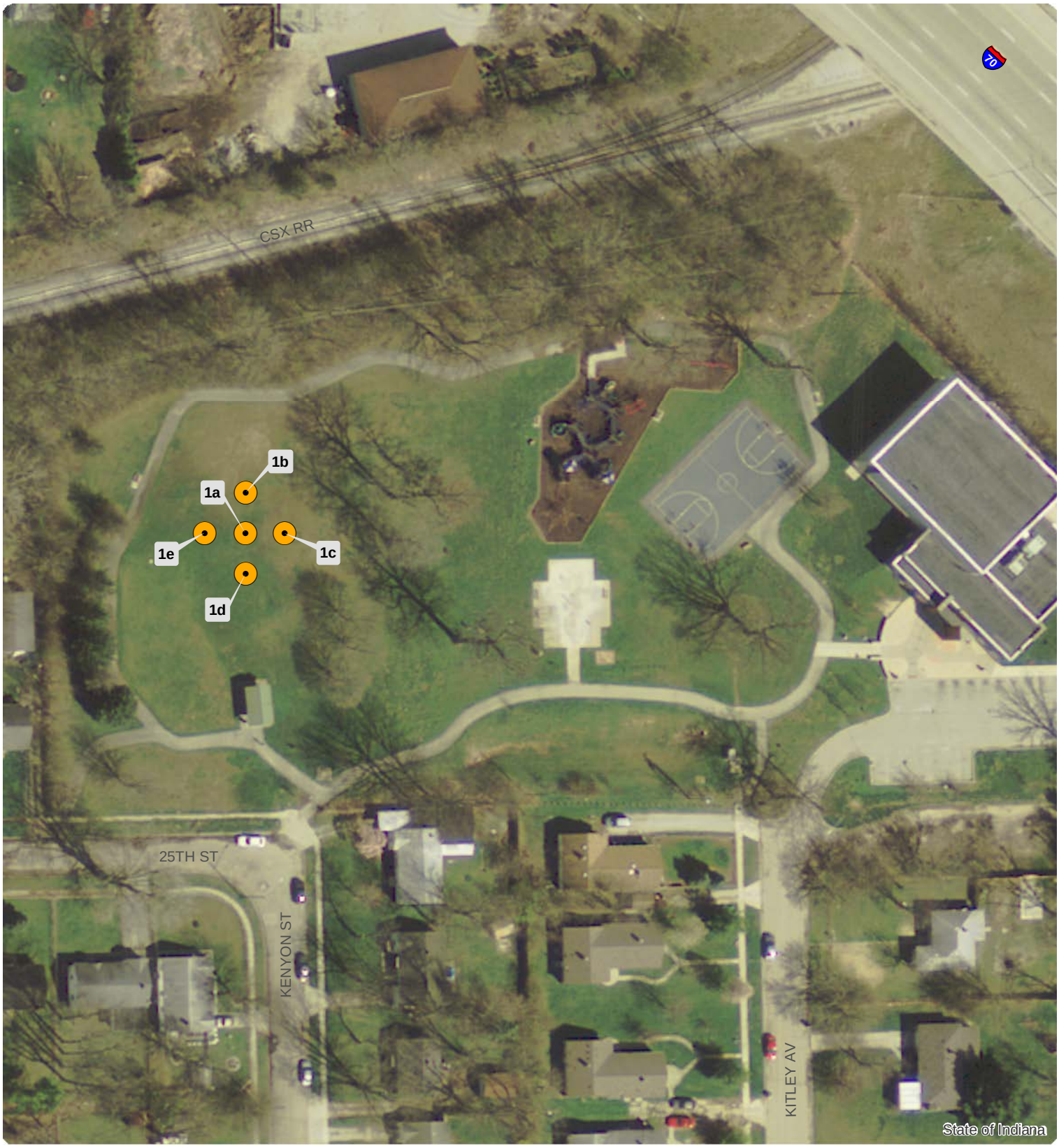


MAP 55

Windsor Village Park



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Cyndi Jones
Office of Land Quality
Date: May 21, 2018

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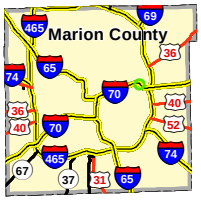

MAP 56

Attachment B

- Sample Results –

Table 1 – Arsenic

Table 2 – Lead

TABLE B-1

Sample Location	Sample Number	Arsenic mg/kg
Al E. Polin Park	OL1659	6.6
Andrew Ramsey Park	OL1662	7.4
Arsenal Park	OL1688	9.1
Beckwith Memorial Park	OL1639	9.6
Bertha Ross Park	OL1658	8.9
Bethel Park	OL1635	7
Bluff Road Park	OL1643	8.6
Broadway and 61st St	OL1686	7.1
Canterbury Park	OL1687	11
Centennial and Groff Park	OL1665	7.3
Christina Oaks Park	OL1645	5.9
Denver Park	OL1653	7.8
Doris Cowherd Park	OL1681	6.5
Douglass Park	OL1638	5.8
Dr. Martin Luther King, Jr. Park	OL1678	11
Edna Balz Lacy Park	OL1630	13
Ellenberger Park	OL1624	7.6
Ellenberger Park	OL1625	12
Elwood and Mary Black Park	OL1661	8.3
Faculty Park	OL1655	5.2
Frank and Judy O'Bannon Old Northside Soccer Park	OL1674	12
Gardner Park	OL1682	14
Garfield Park	OL1631	6.4
Garfield Park	OL1633	6.4
Gateway West Park	OL1656	6.2
Haughville Park	OL1672	9.7
Hawthorne Park	OL1673	9.6
Highland Park	OL1627	11
Indianola Park	OL1652	10

Sample Location	Sample Number	Arsenic mg/kg
John Ed Park	OL1675	9.2
JTV Hill Park	OL1677	9.9
Juan Solomon Park	OL1657	7
Kelly Park	OL1636	65
Kelly Park	OL1886	33
Kelly Park	OL1888	7.2
Lentz Park	OL1664	9.9
Max Bahr Park	OL1671	7.8
McCarty Triangle Park	OL1650	9.8
Moreland Park	OL1666	6.4
Olin Park	OL1670	5
Orange Park	OL1637	11
Oscar Charleston Park	OL1640	5.9
Porter Playfield	OL1629	19
Rhodius Park	OL1648	7.8
Riverwood Park	OL1685	8.5
Roselawn Park	OL1680	5.2
Ross Claypool Park	OL1646	19
Stamm Park	OL1683	8.9
Stout Field Park	OL1644	6.5
Stringtown Park	OL1651	8.5
Tarkington Park	OL1663	9.1
Thatcher Park	OL1669	9.9
Virginia Lee O'Brien Park	OL1623	6.9
Washington Park	OL1642	7.4
Watson Road Bird Perserve	OL1660	9.1
Wes Montgomery Park	OL1679	7.3
Willard Park	OL1626	14
Windsor Village Park	OL1622	9.6

TABLE B-2

Sample Location	Sample Number	Lead mg/kg
Al E. Polin Park	OL1659	43
Andrew Ramsey Park	OL1662	31
Arsenal Park	OL1688	29
Beckwith Memorial Park	OL1639	19
Bertha Ross Park	OL1658	25
Bethel Park	OL1635	26
Bluff Road Park	OL1643	21
Broadway and 61st St	OL1686	20
Canterbury Park	OL1687	19
Centennial and Groff Park	OL1665	22
Christina Oaks Park	OL1645	30
Denver Park	OL1653	33
Doris Cowherd Park	OL1681	18
Douglass Park	OL1638	73
Dr. Martin Luther King, Jr. Park	OL1678	110
Edna Balz Lacy Park	OL1630	140
Ellenberger Park	OL1624	42
Ellenberger Park	OL1625	23
Elwood and Mary Black Park	OL1661	110
Faculty Park	OL1655	17
Frank and Judy O'Bannon Old Northside Soccer Park	OL1674	76
Gardner Park	OL1682	37
Garfield Park	OL1631	32
Garfield Park; Regional Park	OL1633	46
Gateway West Park	OL1656	14
Haughville Park	OL1672	210
Hawthorne Park	OL1673	64
Highland Park	OL1627	37

Sample Location	Sample Number	Lead mg/kg
Indianola Park	OL1652	98
John Ed Park	OL1675	260
JTV Hill Park; Community Park	OL1677	200
Juan Solomon Park	OL1657	18
Kelly Park	OL1636	240
Lentz Park	OL1664	78
Max Bahr Park; Neighborhood Park	OL1671	47
McCarty Triangle Park	OL1650	59
Moreland Park	OL1666	17
Olin Park	OL1670	24
Orange Park	OL1637	54
Oscar Charleston Park	OL1640	35
Porter Playfield	OL1629	160
Rhodius Park	OL1648	30
Riverwood Park	OL1685	19
Roselawn Park	OL1680	21
Ross Claypool Park	OL1646	50
Stamm Park	OL1683	12
Stout Field Park	OL1644	22
Stringtown Park	OL1651	120
Tarkington Park	OL1663	15
Thatcher Park	OL1669	42
Virginia Lee O'Brien Park	OL1623	17
Washington Park	OL1642	26
Watson Road Bird Perserve	OL1660	58
Wes Montgomery Park	OL1679	31
Willard Park	OL1626	74
Windsor Village Park	OL1622	17

Attachment C

General statistics

Table C-1

Statistical Information

Indianapolis Parks	Arsenic	Lead
	mg/kg	mg/kg
Number of Samples	58	56
Minimum	5.00	12.00
Maximum	65.00	260.00
Average	10.26	57.34
Median	8.55	32.50
90 Percentile	13.30	130.00
Standard Deviation	8.47	58.27

Rural Indiana (USGS)[1]	Arsenic	Lead
	mg/kg	mg/kg
Number of Samples	56	56
Minimum	2.40	8.10
Maximum	94.50	259.00
Average	9.10	28.70
Median	8.10	21.80
90 Percentile	10.90	37.00
Standard Deviation	11.90	33.60

[1] Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, and Ellefsen, K.J., 2014, Geochemical and mineralogical maps for soils of the conterminous United States: U.S. Geological Survey Open-File Report 2014–1082, 386 p., http://dx.doi.org/10.3133/ofr20141082.