

Campus Network . Interlined Adjunct Route Network . Increased Trunk Frequency . Redesigned W Corridor . Rerouted Service to Bellefonte . Simplified Peak-Only Routes . Other Notes

Network Changes

Maximize efficiency of buses currently operating to speed trips and expand accessible destinations

Campus Network

Consolidate transit services on campus to provide more direct, more frequent service to all parts of campus and downtown.

EXISTING CONDITIONS

Campus Shuttles are less frequent versions of their Loop counterparts for the busiest portions of their routes. Because they have slightly different routes and different stop locations, passengers cannot easily wait for either a Campus Shuttle or Loop going to the same place.

Because Campus Shuttles are less visible on campus, potential riders are less aware of where they could take the bus.

Duplicate facilities and administration are necessary for upkeep and operation of Campus Shuttles separate from CATA buses.

The Campus Shuttle loops' parallel sides are far apart enough to ensure most passengers must ride around the whole loop for a round trip, but the loops are oblong enough to be annoying to ride all the way around. This is remedied somewhat by the

route traveling in the opposite direction, but **the shuttle on Beaver Ave has a frequency of 35 minutes, which is the same amount of time it takes to walk between the two stops on the shuttle farthest from each other.**

ISSUES RESOLVED

Shuttle service offers a connection between Curtin Rd and Pollock Rd directly via Bigler Rd [**A**], rather than through the stadium parking like the Blue Loop's route. The 35-minute headway northbound direction is paralleled by the White Loop, which provides service to more destinations including central campus on a slightly longer route with significantly improved frequency. V, N, R, W, K, F, S, A, and G routes serve the more frequent southbound direction and would provide free service with the implementation of a fare-free zone on campus [[see Fare-Free Zone](#)]. Other benefits include:

- These CATA routes serve Curtin Rd through central campus where there are more potential riders, rather than through East Halls
- These CATA routes combined have similar to vastly higher frequencies compared to the College Ave Campus Shuttle

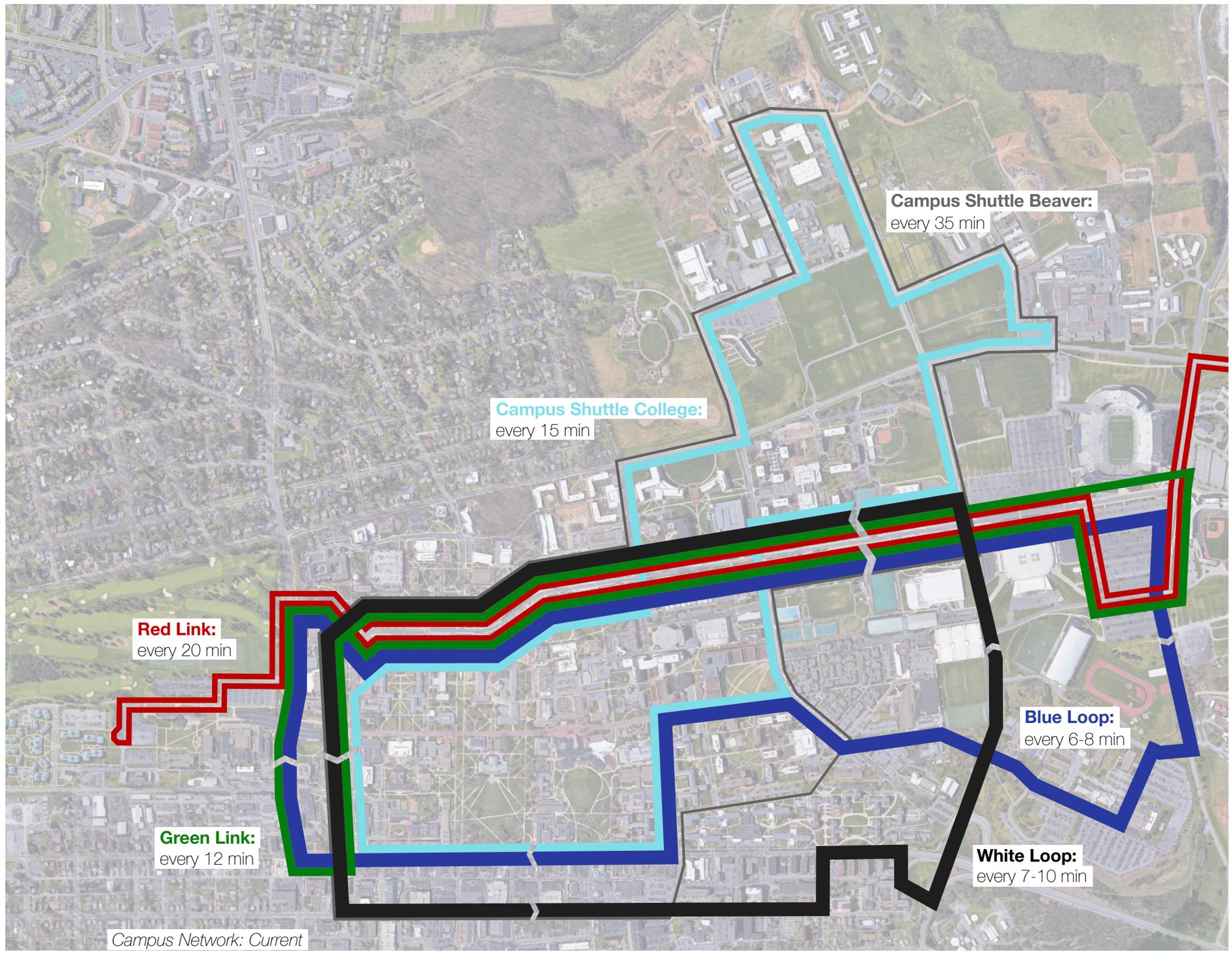
- These CATA routes offer service until late night, on weekends, and when Penn State is not in session

Service to stops on Shortlidge Rd near the business building would no longer be served directly [**B**]. New Loop and Link stops could be located at the greenway beside the Creamery [**b1**], just under 950 feet from the atrium of the business building—as compared to just over 550 feet from the Campus Shuttle stops—and closer to other buildings served by the existing stop. Advantages include:

- Significantly improved frequency in both directions to more popular destinations
- Stops between the Visual Arts building stops [**b2**] and East Halls



Beaver Ave Campus Shuttle at Beaver Hill Apartments. This shuttle duplicates the White Loop downtown but does not stop here or at the CATA office



Campus Shuttle Beaver:
every 35 min

Campus Shuttle College:
every 15 min

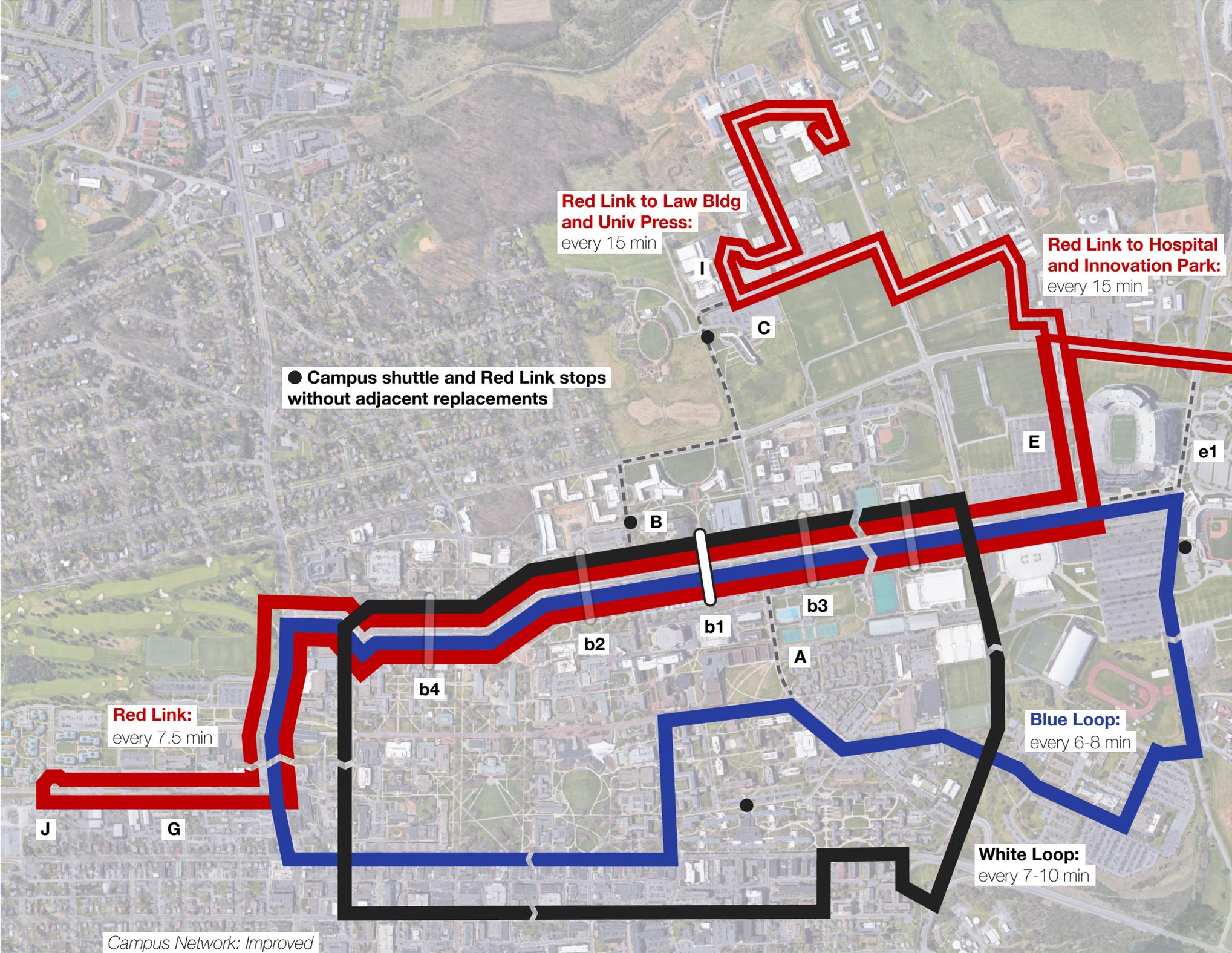
Red Link:
every 20 min

Green Link:
every 12 min

Blue Loop:
every 6-8 min

White Loop:
every 7-10 min

Campus Network: Current



**Red Link to Law Bldg
and Univ Press:**
every 15 min

**Red Link to Hospital
and Innovation Park:**
every 15 min

● **Campus shuttle and Red Link stops
without adjacent replacements**

Red Link:
every 7.5 min

Blue Loop:
every 6-8 min

White Loop:
every 7-10 min

J

G

b1

b2

b4

b3

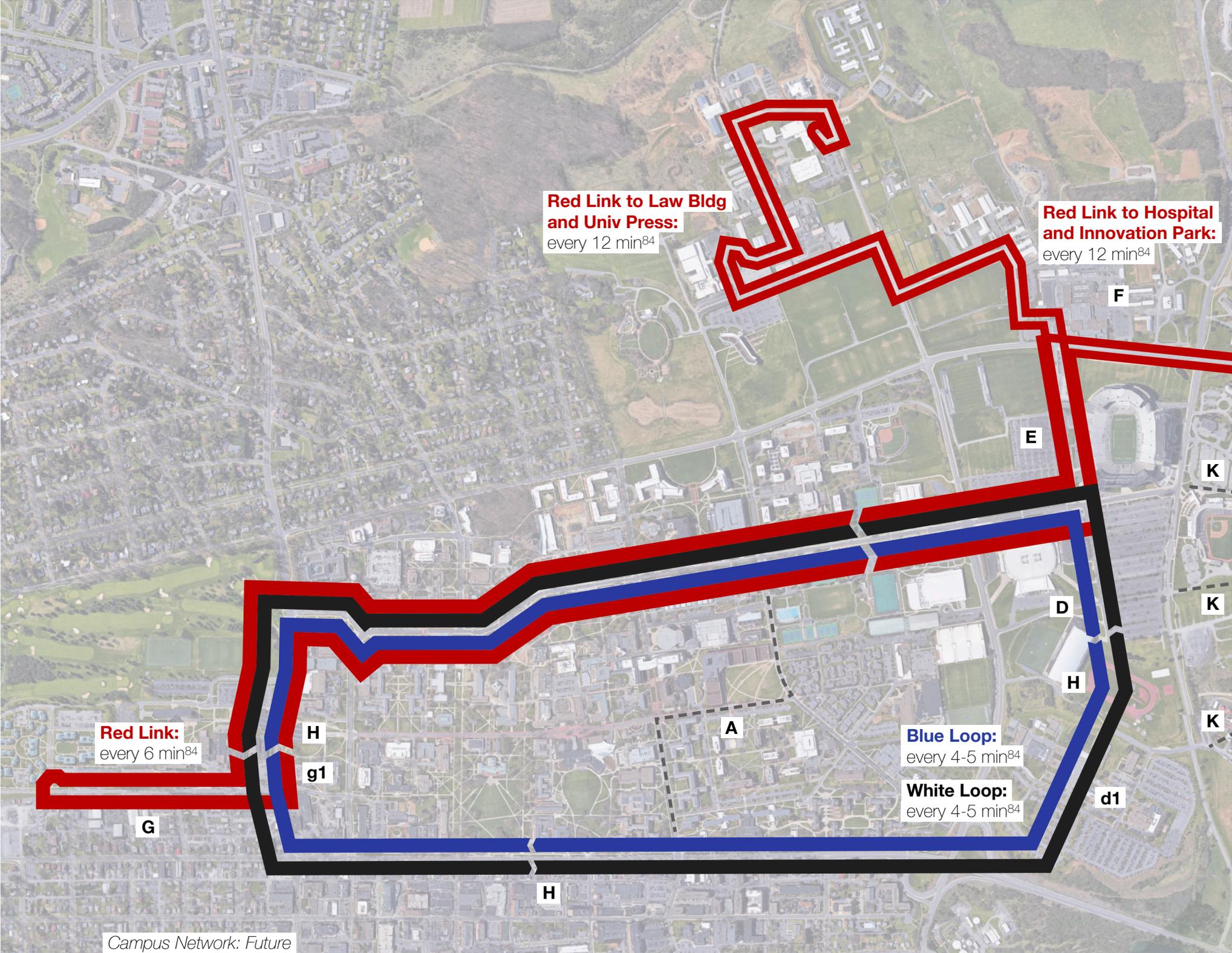
A

B

C

E

e1



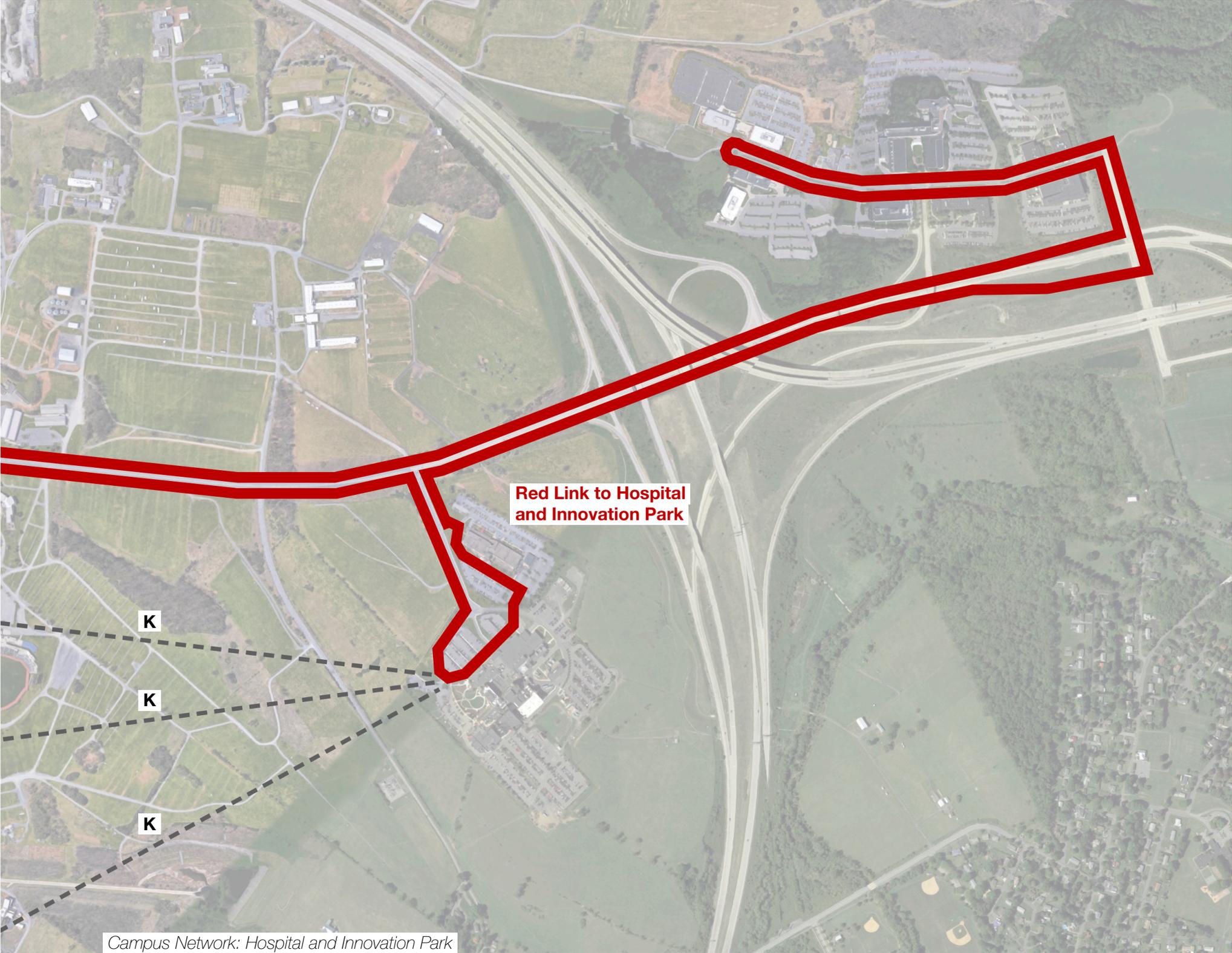
**Red Link to Law Bldg
and Univ Press:**
every 12 min⁸⁴

**Red Link to Hospital
and Innovation Park:**
every 12 min⁸⁴

Red Link:
every 6 min⁸⁴

Blue Loop:
every 4-5 min⁸⁴

White Loop:
every 4-5 min⁸⁴



**Red Link to Hospital
and Innovation Park**

K

K

K

stops [**b3**] shrink the distance between stops from 1950 feet to 1050 feet to Visual Arts and 900 feet to East Halls, much closer to the 1200 feet between Pattee Transit Center [**b4**] and the Visual Arts building stops.⁸⁵ These distances are slightly less than standard international best practice, but are more reasonable for short trips like the ones served by the Loops⁸⁶

- These stops will serve future buildings in the location of the existing greenhouses on both sides of Curtin Rd well
- These stops could be used by community service as well, potentially encouraging moving the computer building stop farther down Bigler Rd

- The stops could be branded as business building stops, aided by the visual connection of the greenway, to encourage the association with the high-activity building

The stops in front of the the law building would be replaced by stops behind the building [**C**]. Slightly longer walks from the Arboretum and longer bus rides to the center of campus would be replaced by more visible, more frequent service to central campus, no longer stopping at OPP for schedule padding and an operator break.

In the future, Blue and White Loop service would be routed on the proposed Stadium Drive⁸⁷ [**D**] and a future extension to the south connecting to College Ave through a

potential mixed-use, dense extension of downtown⁸⁸ [**d1**]. Jordan East parking would be served by stops on the BJC side of the parking lot, which would be more convenient because they would be in the direction of central campus. The closest stop to Medlar Field would be 500 feet farther from the stadium's entrance. Closer White Loop service would provide better frequencies West on Curtin Rd than existing Green and Red Link services. In the interim, better Red Link service to Stadium West lots [**E**] would compensate for the loss of Red Link and Green Link service to Jordan East.

Both Red Link routes would run on the proposed Stadium Drive⁸⁹ [**E**] to allow for a shorter detour on the Law Building and University Press branch while keeping frequency higher on

⁸⁴ Estimated headways with all improvements, including future Loop routing changes, all-door boarding [[see Proof-of-Payment & All-Door Boarding](#)], articulated buses [[see Articulated Buses](#)], and bus lanes [[see Bus Lanes](#)]. These changes increase capacity enough to eliminate the need for one bus to follow another at class changes. Based on proposed number of buses for Red Link and alternate number of buses for Loops.

⁸⁵ All distances measured from eastbound stops.

⁸⁶ Alon Levy, "Sometimes, Bus Stop Consolidation is Inappropriate," [Pedestrian Observations](#), October 30, 2018.

⁸⁷ Populous, "Athletics Facilities Master Plan," Penn State University, February 2017, 22.

⁸⁸ see Downtown East Redevelopment created for use by the State College Borough at jamesgraef.com/downtown-east. James Graef, 2019.

⁸⁹ [Penn State University, "Athletics Facilities," 22.](#)

⁹⁰ Number of buses and headways are measured during daytime weekdays during full service. Span of service might depend on funding, as current Green Link and Campus Shuttle routes only operate during these times.

Existing Routes

	Blue Link	White Link	Red Link	Green Link	Campus Shuttle College Ave	Campus Shuttle Beaver Ave
cycle time	22 including break	20 including break	46 + 10 break at west campus + 4 break at innovation park	24 including break	23 + 7 break	29 + 6 break
number of buses ⁹⁰	3-4	2-4	3	2	2	1
headway (minutes)	6-8	7-10	20	12	15	35

Proposed Routes

	Blue Link	White Link	Red Link to Hospital and Innovation Park	Red Link to Law Building and Univ Press
cycle time	22 including break	20 including break	47 + 7 break at west campus + 6 break at innovation park -or- + 2 break at innovation park and service to Hospital inbound	53 + 7 break at west campus
Proposed: additional frequency on Red Link				
number of buses	3-4	2-4	4	4
headway (minutes)	6-8	7-10	15 branch / 7.5 core (equivalent: RL+GL evenly spaced)	
future headway ⁸⁴	4-5	4-5	12 branch / 6 core	
Alternate: additional frequency on Loops				
number of buses	4-5	3-5	3	3
headway (minutes)	4-6	6-8	20 branch / 10 core	

Stadium Drive. Higher frequencies near Stadium West parking would make access to central campus from this parking lot more convenient. The route change from Porter Rd could be implemented separately if Stadium Drive is not complete when other route changes are implemented [e1].

Integrating staff and equipment from Penn State Transportation Services into CATA will be challenging. One Red Link branch could be operated by the existing Penn State staff separate from CATA for an interim period. The branch should be branded as a CATA service paid for by Penn State to maintain consistency with other campus service. The branch should use CATA buses to maintain consistent branding, but the buses could be stored at the existing Penn State bus storage site except when maintenance is required. In the

future, the area around OPP [F] might be a good location for a new bus depot, and this arrangement could start coordination [see second CATA depot]. In the future the shuttle operators could become CATA employees. Red Link buses should be 40 foot or larger buses, but existing Campus Shuttle buses could be transferred to CATA peak-only community service routes or CATARide services.

NEW ADVANTAGES

The Red Link routing would offer higher frequency service on more direct routes to buildings north of Park Ave, the hospital, and Innovation Park.

Loop and Link routes would offer higher and more consistent frequencies on Curtin Rd, downtown, and in areas

around College Ave and Atherton St, including Walker Building.

Loop and Link routes would provide more visible service where they replace Campus Shuttle routes.

Places where the Red Link replaces the Green Link, including West Campus, would see increased frequencies and increased service afternoons, evenings, nights, and weekends.

Red Link service on the Old Railroad Grade would offer higher frequency on a route closer to West College Ave urban village [G]. Frequent service to West College Ave replaces and adds to existing Green Link capacity at Walker Building with more convenient service for most people. The same service is also more convenient for people traveling from East Halls to West College Ave late Friday and Saturday nights, relieving crowding on White Loop service.

Limited investment would be necessary to create a contra-flow bus lane or two way street through the Greyhound bus station and along the Old Railroad Grade and to create a bus turn around at Duff Dr near the White Course Apartments. This route change could be implemented after other changes depending on funding availability.

The stop at Walker Building should be moved north of the intersection with the Greyhound Bus Station [g1] to



Blue Loop arriving to almost 100 riders waiting for it at a class change

allow buses on the new Red Link route to stop at the same stops as buses on Atherton St, like the Green Link does currently. This will also allow for transit signal priority [[see Transit Signal Priority](#)]. Changes to the northbound stop should happen in conjunction to the addition of a southbound stop at the Walker Building, before or with the implementation of the Atherton Transitway [[see Atherton Transitway](#)].

Converting College Ave—or Beaver Ave—to a two-way transitway [[see Bus Lanes](#)], routing the While Loop via Atherton St, and combining both Loops between University Dr and Porter Rd [[see Stadium Drive](#)] would allow for the Loops to be seen as a single route in both directions [**H**].

STRATEGY OPTIMIZATION

The Red Link to Law Building and Univ Press route accesses the Law Building and Arboretum [**I**] before and after stops to the North because predicted ridership to these destinations is higher, but the route could access University Press before the Law Building if ridership warrants the change. A loop should be avoided because a schedule padding and

operator break will likely be necessary, meaning riders on each side of the loop will need to wait onboard in one direction.

OPPORTUNITIES & POSSIBILITIES

In the future, all buses on College Ave and Beaver Ave west of Atherton St could be consolidated onto the Old Railroad Grade, creating a unified, frequent trunk west of downtown. This trunk would be significantly stronger with increased frequency from a redesigned W corridor [[see Redesigned W Corridor](#)]. A connection between W Campus Dr near Duff Dr and College Ave would be necessary for continuous service, [**J**] potentially as part of the West Campus parking garage project.⁹¹

The W route could become the Red Link downtown and on campus, more efficiently using revenue hours. A fare-free zone on campus [[see Fare-Free Zone](#)] would easily allow for fare collection on the W route, and allow the Red Link to remain free near West Campus and on the rest of its current route. Some Red Link buses could short turn where they do currently and others could continue, allowing for a

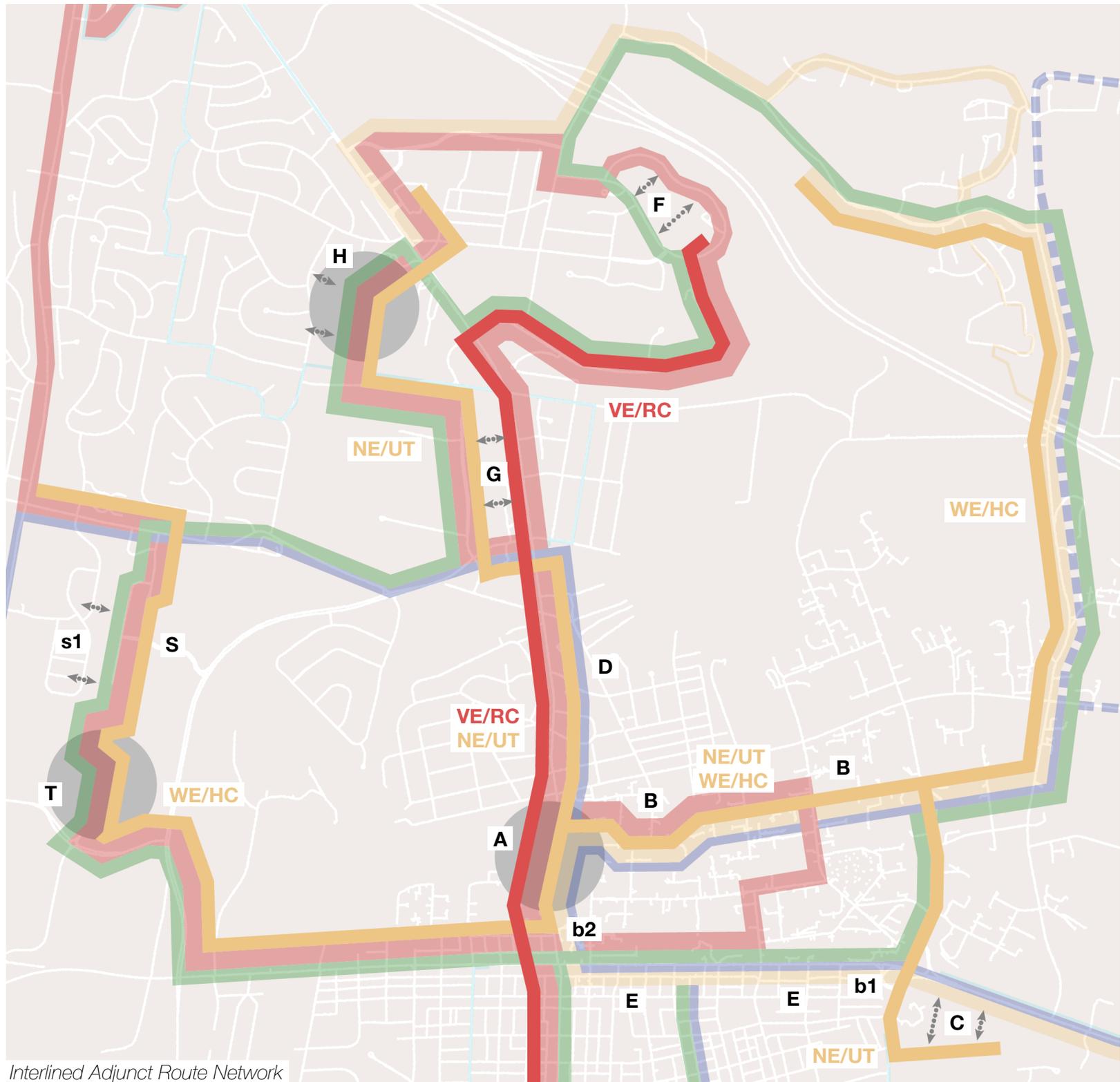
range of frequencies. This route and a redesigned WE/HC route [[see Interlined Adjunct Route Network](#)] would create one, more frequent corridor on Curtin Rd for all daytime services to destinations on the W corridor, reducing reverse branching.⁹² NV and VN would provide service directly to all of downtown nights and weekends. **Some students are already hesitant to ride the Red Link because they are afraid they will end up at Innovation Park or West Campus, so education and advertising would be necessary to inform students where the route goes.**

Future expansion of campus East past Porter Rd, including potential changes to football tailgating fields⁹³ should attempt to create a connection between Porter Rd and Mount Nittany Medical Center [**K**] so the Red Link branch does not need to detour to serve the hospital and can serve it in both directions easily.

⁹¹ CNET, “State College Borough Council Meeting,” State College Municipal Building, November 19, 2018, 16:53.

⁹² Alon Levy, “The Wrong Kind of Branching,” Pedestrian Observations, February 4, 2015.

⁹³ Penn State University, “Athletics Facilities,” 84-86.



Interlined Adjunct Route Network

Interlined Adjunct Route Network

Interline NE, WE, HC, and UT routes to serve campus more completely and to decrease overall trip time.

Interline VE and RC routes to create an Atherton trunk which can be expanded in the future.

EXISTING CONDITIONS

Existing trunk routes waste revenue hours and rider time looping around campus and downtown, but adjunct routes—express and campus services—generally do not serve campus and downtown well.

The HU route planned in the Fall 2019 service changes will serve campus and downtown well, but the Toftrees and Bellaire Ave corridors are the two lowest-ridership adjunct routes.

NEW ADVANTAGES

The VE/RC route grants VE buses easy access to downtown at Atherton St [**b2**] and creates a bus line running a significant length solely on Atherton St. These services could be combined today, with buses looping through Pattee Transit Center in both directions, but the Atherton Transitway [[see Atherton Transitway](#)], or at least bus stops in both directions at Rec Hall and Walker Building on Atherton St [**A**] would allow for routing on Atherton St without detours.

The HU route implemented in Fall 2019 would be separated, and the segments running the length of campus and downtown would be used to connect the HU route to the NE and WE routes [**B**]. The NE is connected to the UT [**b1**] and the WE is connected to the HC [**b2**] to allow both routes to access downtown on opposite sides. The WE/HC route could be interlined via Atherton St before W corridor changes [[see Redesigned W Corridor](#)] occur, although the route would not see the benefits of serving downtown.

Campus Service changes [[see Campus Network](#)], especially with the Atherton Transitway [[see Atherton Transitway](#)] and a transitway on College Ave or

Beaver Ave [[see Bus Lanes](#)], would allow riders to transfer to extremely frequent campus services to access the rest of campus and downtown from adjunct routes.

STRATEGY OPTIMIZATION

Through-running routes should be branded as single routes to advertise one-seat rides, especially along Atherton St.

Create pedestrian and bike connections between Bellaire Ave and College Ave to allow UT riders to access service on College Ave more easily [**C].** This will allow the NE/UT to stop serving Bellaire Ave directly and be extended to the Mall as development occurs, creating a more complete only-adjunct network.

All adjunct services on N Atherton St should serve stops on N Atherton St, rather than becoming express, so they function more like trunk routes [**D**] [[see VE RC BRT](#)], and so the route serves all of Atherton St [[see Atherton Hub](#)]. The N Atherton St corridor would become the most attractive corridor outside downtown for dense, mixed-use development.⁹⁴

⁹⁴ see North Atherton Redevelopment created for use by Ferguson Township at jamesgraef.com/atherton. James Graef, 2017.

OPPORTUNITIES & POSSIBILITIES

The VE/RC route should be encouraged to develop into a bus rapid transit⁹⁵ (BRT)-like corridor along Atherton St, with an emphasis on serving commercial development to encourage diverse community ridership. As N Atherton St develops, and especially with the development of Patton Crossing, the VE and NE branches could be swapped—NE/RC and VE/UT or a future Mall adjunct route—to keep the Atherton St corridor closer to Atherton St all the way to The Colonnade. Dense, walkable development should be encouraged on the entire length of S Atherton St stretching south from downtown, eventually dwarfing development on Waupelani Dr, to allow the transit corridor to continue to important commercial destinations like Hills Plaza, and to market the corridor as serving all of Atherton St.

The existing interlining of the RC and WE routes should be advertised by changing RC buses to WE signage before downtown and the Walker Building, like the N and R routes do, to allow WE riders service to and from downtown before all six routes are interlined.

The NE/UT route could route through downtown, rather than Curtin Rd, to create a more complete adjunct route network [**E**]. A stop at Rec Hall on Atherton St and increased and more efficient Campus Service would allow riders to access all of central campus [**A**].

More resources should be given to adjunct routes as they evolve into more efficient trunk routes. For example:

- When efficiency and funding allow for shorter headways on trunk corridors [see Increased Trunk Frequency], trunk route headways could be changed to 30 minutes rather than 15 on-peak and 30 off-peak, and adjunct route headways could be doubled to 10 minutes, rather than increased to only 15.
- Adjunct and circulator service could be added on weekends and during reduced service to add needed trunk capacity or to replace trunk service. Increases in efficient circulator service and adjunct routes which serve the edges of downtown [**b1**, **b2**] would compensate for lost inefficient trunk service downtown. Pedestrian connections should be improved in places like Oakwood Ave, between the current V and NV/

VN routes, to ease riders through the transition [**F**].

- **Investigate replacing circulator route service late-night, especially Friday and Saturday, with adjunct route service.** Late night Friday and Saturday are some of the most productive times for all three circulator routes⁹⁶ and most ridership on the NV and VN routes comes from The Heights and Toftrees. Circulator service could be replaced by WE/HC service via downtown rather than campus—potentially branded as a different route—and VE/RC service on Atherton St, also replacing RP service. VE service would be within walking distance of Martin St and Aaron Dr, especially with additional pedestrian and bike connections between Atherton St and Martin St [**G**]. These routes would provide faster trip times, simplify service patterns, and potentially cost less to operate. When NE/UT service is extended to the Mall and the Villas at Happy Valley rather than Bellaire Ave, it could also operate via downtown late nights similar to WE/HC service.

⁹⁵ "The Bus Rapid Transit Standard," Institute for Transportation & Development Policy, June 21, 2016.

⁹⁶ Centre Area Transportation Authority, "Assessment of Articulated Bus Utilization," 20-94.

Increased Trunk Frequency

Implementing all-door boarding and dedicated transit right-of-way will increase bus speed and reliability

enough to allow the interlined V, N, and R routes to run on 30 rather than 40 minute headways with just one additional bus.

Implementation of the interlined adjunct routes [see [Interlined Adjunct Route Network](#)] and slight schedule modifications will allow all adjunct routes to run on 15 minute headways.

EXISTING CONDITIONS

Adjunct and trunk services are almost universally full during peaks and crowded at all other times. Adjunct services like the VE and RC often have two buses running together constantly or occasional tripper buses for extra capacity.

40 minute frequencies are inconvenient for riders to remember and for CATA to

Current Interlined Trunk Scheduling

Route	V		N		R		N		V				
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	College & Allen	Col-onnade	Col-onnade	College & Allen	College & Allen	Stratford Dr	Stratford Dr	College & Allen	College & Allen	Col-onnade	Col-onnade	College & Allen	College & Allen
Min to next point	20	7	27	0	9	5	26	0	21	6	29	0	
Timestamp	0:00	0:20	0:27	0:54	0:54	1:03	1:08	1:34	1:34	1:55	2:01	2:30	2:30
Example trip	10:18	10:38	10:45	11:12	11:12	11:21	11:26	11:52	11:52	12:13	12:19	12:48	12:48

Proposed Interlined Trunk Scheduling

Route	V		N		R		N		V				
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	College & Allen	Col-onnade	Col-onnade	College & Allen	College & Allen	Stratford Dr	Stratford Dr	College & Allen	College & Allen	Col-onnade	Col-onnade	College & Allen	College & Allen
Min to next point	20	7	27	3	9	5	26	3	21	6	29	4	
Timestamp	0:00	0:20	0:27	0:54	0:57	1:06	1:11	1:37	1:40	2:01	2:07	2:36	2:40
Example trip	10:18	10:38	10:45	11:12	11:15	11:24	11:29	11:55	11:58	12:19	12:25	12:54	12:58

Current / Potential Fall 2019 Interlined Adjunct Route Scheduling

Route	VE				NE				VE
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	Oak-wood	Oak-wood	Pattee TC	Pattee TC	Trader Joe's	Trader Joe's	Pattee TC	Pattee TC
Min to next point	11	17	12	0	14	11	15	0	
Timestamp	0:00	0:11	0:28	0:40	0:40	0:54	1:05	1:20	1:20
Example trip	10:19	10:30	10:47	10:59	10:59	11:13	11:24	11:39	11:39

Route	RC				WE				RC
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	CATA Depot	CATA Depot	Pattee TC	Pattee TC	The Heights	The Heights	Pattee TC	Pattee TC
Min to next point	17	14	17	0	14	9	9	0	
Timestamp	0:00	0:17	0:31	0:48	0:48	1:02	1:11	1:20	1:20
Example trip	10:14	10:31	10:45	11:02	11:02	11:16	11:25	11:34	11:34

Route	HC				UT				HC
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	The Station	The Station	Pattee TC	Pattee TC	Bellaire Ave	Bellaire Ave	Pattee TC	Pattee TC
Min to next point	12	7	14	0	13	14 ⁹⁷	11	0	
Timestamp	0:00	0:12	0:19	0:33	0:33	0:46	1:00	1:11	1:11
Example trip	10:31	10:43	10:50	11:04	11:04	11:17	11:31	11:42	11:42

write because they do not repeat on the hour [[see Stop Info Panels](#)].

ISSUES RESOLVED

All redesigned adjunct route groups [[see Interlined Adjunct Route Network](#)] can use the same amount of buses to run at 15 minute headways, with fewer breaks for schedule padding⁹⁸ because bus lanes [[see Bus Lanes](#)] and all-door boarding [[see Proof-of-Payment & All-Door Boarding](#)] allow for higher speed and reliability. The VE/RC route is five minutes longer than necessary for 15 minute headways with the same number of buses, but the removal of the loop to serve Pattee, with new stops on Atherton St at Rec Hall [[see Atherton Transitway](#)] would make up more than the necessary five minutes.

The V/N/R triple can be reduced easily to a 2:30 runtime by removing schedule padding breaks at College and Allen made unnecessary by bus lanes [[see Bus Lanes](#)] and all-door boarding [[see Proof-of-Payment & All-Door Boarding](#)],⁹⁹ meaning only one extra bus is necessary to increase

⁹⁷ Wait at Bellaire Ave alternates: 9, 14 minutes

⁹⁸ Schedule padding goal of 12 minutes, 8 minimum. [Alon Levy, "Boston NightBus: Planning Around Timed Connections," Pedestrian Observations, January 5, 2017.](#)

⁹⁹ [Alon Levy, "Bus Bunching."](#)

Proposed Interlined Adjunct Route Scheduling

Route	RC				VE				RC
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	CATA Depot	CATA Depot	Pattee TC	Pattee TC	Oak-wood	Oak-wood	Pattee TC	Pattee TC
Min to next point	17	8	17	0	11	0	12	0	
Timestamp	0:00	0:17	0:25	0:42	0:42	0:53	0:53	1:05	1:05
Example trip	10:14	10:31	10:39	10:56	10:56	11:07	11:07	11:19	11:19

Route	NE				UT				NE
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	Trader Joe's	Trader Joe's	Pattee TC	Pattee TC	Bellaire Ave	Bellaire Ave	Pattee TC	Pattee TC
Min to next point	14	11	15	0	10	0	10	0	
Timestamp	0:00	0:14	0:25	0:40	0:40	0:50	0:50	1:00	1:00
Example trip	10:31	10:45	10:56	11:11	11:11	11:21	11:21	11:31	11:31

Route	HC				WE				HC
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Pattee TC	The Station	The Station	Pattee TC	Pattee TC	The Heights	The Heights	Pattee TC	Pattee TC
Min to next point	12	0	14	0	14	11	9	0	
Timestamp	0:00	0:12	0:12	0:26	0:26	0:40	0:51	1:00	1:00
Example trip	10:31	10:43	10:43	10:57	10:57	11:11	11:22	11:31	11:31

frequency from 40 minutes to 30, and two to increase from 20 minutes to 15 during peaks. Tripper or duplicate buses—no longer-necessary due to higher frequencies or articulated buses [[see Articulated Buses](#)]—could be used as the extra buses on the V/N/R route group.

Future route changes will make scheduling less tight and might reduce the number of buses necessary. For example, routing the N and NE through Patton Crossing via Wolf Ln, rather than Park Ln, with better pedestrian and bike connections between the two [**H**] [[see Simplified Peak-Only Routes](#)], and routing the W and WE through Pine Hall development [**T**] via College Ave rather than on Atherton St and Blue Course Dr [[see Redesigned W Corridor](#)].

Eliminating the schedule padding breaks at College and Allen will make timed transfers more delicate, but this is acceptable:

- The vast majority of riders do not transfer, and their time spent waiting is much more than the increase in wait time for transferring riders
- Bus lanes will decrease variability in trip times dramatically, leading to more reliable timed transfers
- It is possible to walk from Pattee Transit Center to College Ave and Allen St faster than it is to stay on a V, N, R, or W bus, so riders could catch

Existing Routes

	V N R	VE NE	RC WE	HC UT
cycle time	2:40	1:20	1:20	projected: 1:11 1:20 with breaks
headway (minutes)	40	20	20	HC 40 / UT 30,35 Fall 2019: 20
number of buses	4	4	4	current: 2 Fall 2019: 4

Proposed Routes

	V N R	VE RC	NE UT	WE HC
cycle time	2:30	1:00 ¹⁰⁰	1:00	1:00
number of buses	5	4*	4	4
headway (minutes)	30	15	15	15

transfers they otherwise would not be able to catch by walking

- Increased frequency will generally shorten all transfers
- Interlined adjunct routes [[see Interlined Adjunct Route Network](#)] and interlined N and R service provide links through downtown and campus without necessary transfers

STRATEGY OPTIMIZATION

The only remaining routes on 40 minute headways—the HM and W on weekdays—could be changed later to 30 minute headways. Although the HC/WE route could be changed without operating cost increases, it should retain 20 minute headways until the W and HM frequencies are changed to maintain consistent corridor headways. The following would be necessary to transition to 30 minute headways:

W: If, via all-door boarding [[see Proof-of-Payment & All-Door Boarding](#)] and bus lanes [[see Bus Lanes](#)], schedule padding breaks at College and Allen and three minutes of travel time on campus and downtown were removed from the V, N, R, and W routes, the W could be interlined with the V downtown and the four routes could be operated at 30 minute headways with no additional buses, other than the one

¹⁰⁰ 5 buses necessary with 1:15 cycle time while route still detours through Pattee Transit Center before stops are created on Atherton St [[see Atherton Transitway](#)]

necessary for 30 minute V, N, and R service. Reliability concerns should be considered with such a long route, though bus lanes would be installed on the most congested corridors.

Alternatively, removing detours like those on Galen Dr and Amblewood Way in favor of service by the A route [see Simplified Peak-Only Routes] could allow for increased frequency.

HM: one extra bus, without schedule alterations, would probably be necessary to increase HM frequency from 40 to 30 minutes.

OPPORTUNITIES & POSSIBILITIES

Corridor headways could be coordinated with circulator routes already running at 30 and 60 minute frequencies.

Pulses downtown could be coordinated with 60 minute-headway corridor routes.

Redesigned W Corridor

With the construction of the Pine Hall development, the W corridor can easily be routed through College Ave rather than Atherton St, spreading frequent transit service.

The current K route can be rerouted through Atherton St to serve areas previously served by the W and S routes, allowing for the removal of the S route.

EXISTING CONDITIONS

No routes are currently located well to be extended to serve the new Pine Hall development¹⁰¹ next to The Heights.

Commercial buildings on Science Park Rd north of Old Gatesburg Rd only receive peak-only service.

So many routes accessing campus and downtown through Atherton St create an unbalance, prohibiting corridors from being interlined north-south through campus and downtown.

College Ave west of Atherton St is underserved by transit, especially on weekdays, which hurts dense, walkable redevelopment potential.¹⁰²

The KP route to be created in Fall 2019 detours in a loop on Atherton St and Burrowes Rd in both directions to serve the edge of central campus.

ISSUES RESOLVED

Corridor types are maintained so corridor frequencies and spans can be consistent: the W route's Pine Hall/The Heights and Valley Vista are generally clusters of dense residential, whereas the KP route's Science Park Rd and Cato Park are both commercial.

The S route is removed, replaced by rerouted KP and F routes. The entirety of the commercial section of Science Park Rd receives hourly service, rather than peak-only service, with the KP route [I]. Additional pedestrian and bike connections should be created between Barnstable Ln, Sandy Dr, and Science Park Rd [J]. **Because Cato Park is a reverse-peak destination, select peak-direction trips on the KP can replace the S route in Autumnwood without disrupting the**

¹⁰¹ LandDesign, "Pine Hall Traditional Town Development General Master Plan," Ferguson Township, February 15, 2018.

¹⁰² Luke Derda, Dave Eilenberger, Lillian Luu, Rick McDonald, & Jason Miller, "Terraced Streetscape District," Smeal Applied Professional Experience, Penn State University, 2015.

reverse-commutes of most Cato Park riders [K]. Service to Science Park Rd and Cato Park passes Atherton at Blue Course [L], allowing riders on the V and N corridors—and W corridor at Circleville Rd [I1]—to transfer to the KP without traveling downtown, aided by a future Atherton Hub [[see Atherton Hub](#)]. Cato Park is also served on the opposite side of town by the slightly more direct RC route from campus and downtown [M].

F service travels on Westerly Pkwy rather than Bayberry Dr to serve almost all riders of the S before Science Park Rd. Pedestrian and bike connections between Bayberry Dr and Southgate Dr [N] should be expanded to allow current F route riders to access the more frequent R corridor. Pedestrian and bike connections between The Landings and Sylvan View [O] and between Westway Gardens and Shamrock Estates [P] should be expanded to allow better access to the F route.

NEW ADVANTAGES

Because the K portion of the KP route would access campus and downtown through Atherton St, the loop to central campus would no longer be a detour.

¹⁰³ [Alon Levy, “Wrong Branching.”](#)

W and WE routes move from Atherton St to College Ave [Q] to access Campus and downtown. Service on College Ave allows buses to access the edge of downtown quickly [R], before serving central campus [r1], unlike currently on Atherton St where downtown is first served after all of campus. Both routes should access campus and downtown via the same corridor, College Ave, because reverse branching makes transit significantly less efficient.¹⁰³ Circulator NV and VN service will allow for connections to Giant and destinations on Atherton St; and development on College Ave west of Atherton St will create more commercial destinations on the W corridor.

STRATEGY OPTIMIZATION

W, WE, NV, and VN buses should be routed on Northwick Blvd for its entirety [S], rather than Havershire Blvd, then Southwick Blvd and directly through the Pine Hall development [T] to Old Galesburg Rd at its intersection with Pine Hall Rd. Pedestrian and bike connections should be expanded between Greenleaf Manor and Northwick Blvd for better transit access in Greenleaf Manor [s1].

W, WE, and F buses should turn from Beaver Ave to Atherton St, even

without the Atherton Transitway, if remotely possible, rather than to Burrowes St like the F bus does currently, to standardize routing for almost all routes northbound on Atherton St.

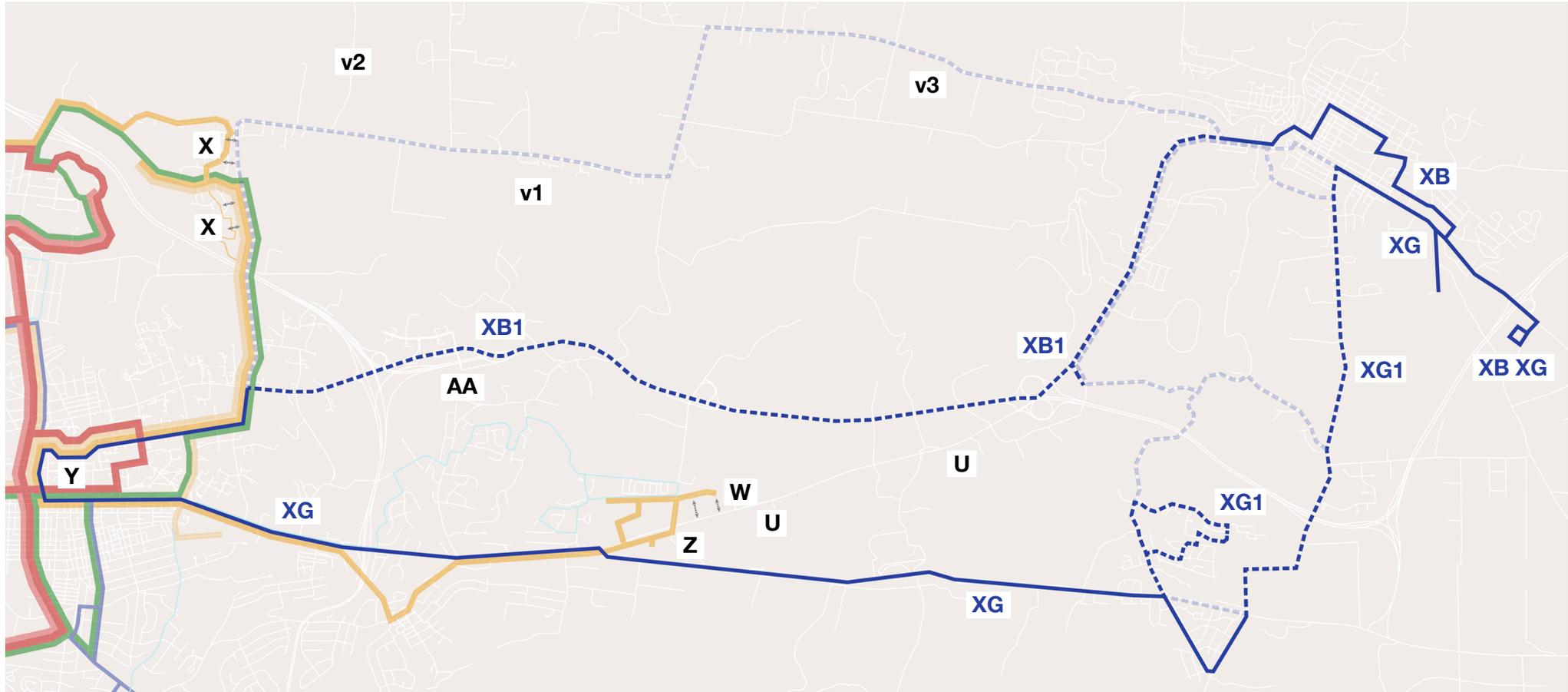
To allow northbound KP buses to stop near central campus, both directions should use Burrowes Rd, until a stop at Rec Hall on Atherton St is created [A].

OPPORTUNITIES & POSSIBILITIES

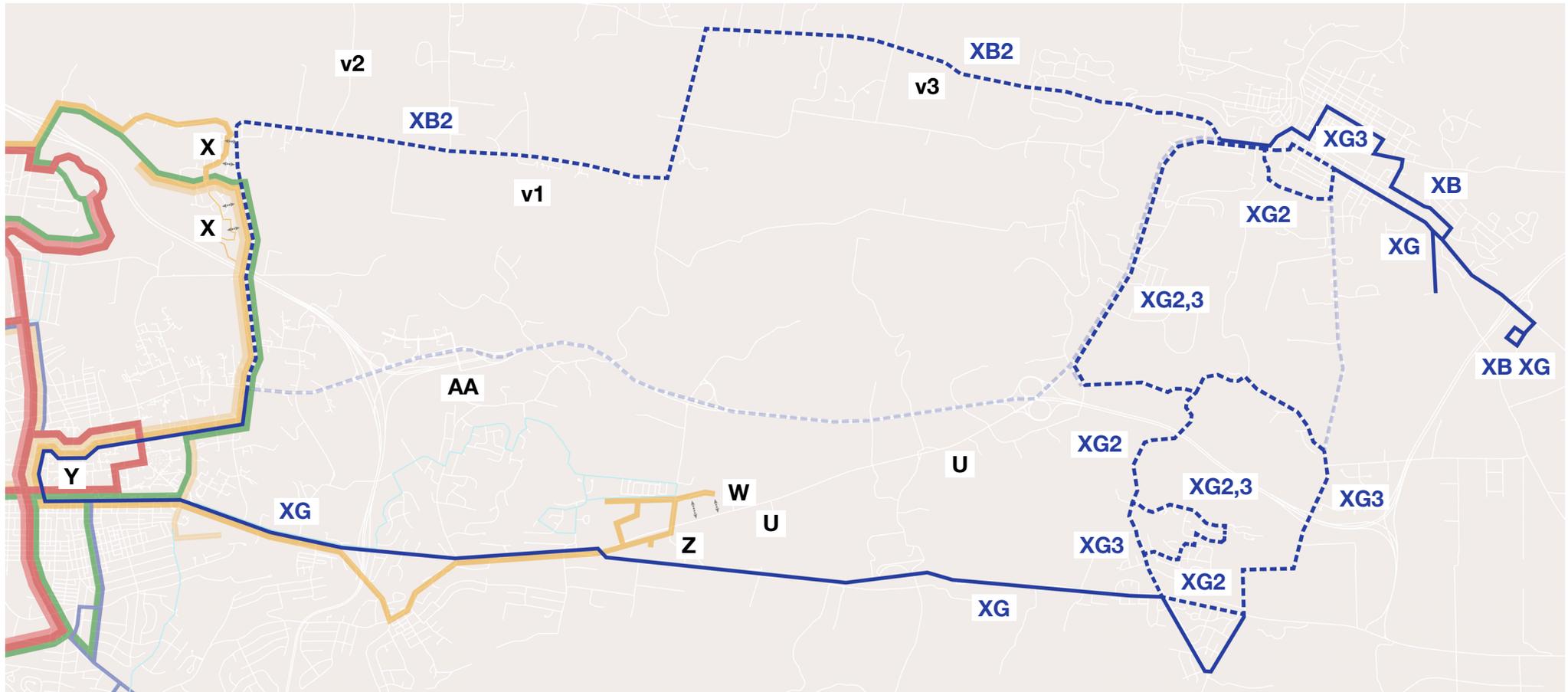
Explore interlining the W route with the Red Link and running the W corridor on the Old Railroad Grade to create more efficient or more frequent service through the West End Village and West Campus [[see interlined W and Red Link](#)].



K route—future KP route—on Burrowes Rd where it will detour to serve campus



Rerouted Service to Bellefonte: Alternatives XB1 and XG1



Rerouted Service to Bellefonte: Alternatives XB2, XG2, and XG3

Rerouted Service to Bellefonte

Separating the XB and XG routes between Bellefonte and State College will allow for faster service to Bellefonte or service to the Airport and development around Route 550.

Shorter route cycles and increased ridership should be used to increase frequency of service to Bellefonte to a 60 minute headway.

EXISTING CONDITIONS

XB service on Benner Pk and College Ave duplicates XG and HM service but does not meaningfully increase frequency.

Service on Benner Pk between Nittany Mall and I99 does not serve any residential or commercial development [U].

University Park Airport [v1], ongoing development nearby in Patton Township [v2], and existing development on Route 550 [v3] currently have no transit service.

Current Interlined Bellefonte Routes Scheduling

Route	XG				XB			XG	
Status	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave	Arrive	Leave
Stop	Weis	CATA: Schlow	CATA: Schlow	Weis	Weis	CATA: Schlow	CATA: Schlow	Weis	Weis
Min to next point	65	3	50	12	51	3	39	9	
Timestamp	0:00	1:05	1:08	1:58	2:10	3:01	3:04	3:43	3:52
Example trip	6:49	7:54	7:57	8:47	8:59	9:50	9:53	10:32	10:41

Proposed Bellefonte Loop Scheduling ¹⁰⁴

Route	XG		XB		XG
Status	Leave	Arrive	Leave	Arrive	Leave
Stop	Weis	College & Allen	College & Allen	Weis	Weis
Min to next point	53	0	57	10	
Timestamp	0:00	0:53	0:53	1:50	2:00
Example trip	6:49	7:42	7:42	8:39	8:49

¹⁰⁴ Showing XB outbound and XG inbound. Another loop in the opposite direction would follow the same schedule in reverse.

XB and XG service is not hourly, but could easily be transitioned to 60 minute headways with the same amount of buses as are used at the peak.

NEW ADVANTAGES

The XB route could run on I99 to Benner Pk [**XB1**] to shorten the route and nudge it and the XG closer to hourly service. Pedestrian and bike connections should be expanded from Premiere Dr to Benner Pk where the XB route would no longer stop [**W**], to allow all parts of Benner Pk with ridership which would lose XB service to still have more frequent HM service. XG service should be maintained on Blanchard St Exd [**XG1**].

Alternatively, the XB route could run on Fox Hill Rd, Rock Rd, and Buffalo Run Rd to Bellefonte [**XB2**]. This route would take the same amount of time as the current route on College Ave and Benner Pk does. This route would have the potential to serve the University Park Airport [**v1**], ongoing development nearby in Patton Township [**v2**], and existing development on Route 550 [**v3**]. The XB route could take over all or part of the HM route through Toftrees, except for Toftrees Ave. Pedestrian and bike connections should be expanded

between Fox Hollow Rd and Woodledge Dr and The Village at Penn State, especially if the XB route stays on Fox Hollow Rd [**X**]. The XG routing could be changed to serve the portion of Benner Pk north of I99 via Axemann rather than Blanchard St Exd [**XG2,3**], or service could be maintained on Blanchard St Exd [**XG1**], even though this road has little ridership outside Bellefonte.¹⁰⁵

Both options would allow the XB and XG to use the HM routing downtown and on campus [**Y**], increasing efficiency and simplifying potential signage transitions between routes downtown and on campus.

The XG route would still allow riders from Bellefonte to access the Nittany Mall [**Z**].

STRATEGY OPTIMIZATION

With the removal of the XG's detour to the Nittany Mall [**Z**], a one-way loop via **XB2** and **XG2** can take two hours, meaning four buses are necessary for hourly service on both routes. This would mean the same number of buses as run at peak would need to run all day for hourly service.

OPPORTUNITIES & POSSIBILITIES

B and C routes could be interlined and routed through downtown and campus like the proposed XB and XG would if the Innovation Park Access Ramp road is connected to Houserville Rd [**AA**].

Simplified Peak-Only Routes

Minimize neighborhoods served by looping service on the B route and decrease winding route segments.

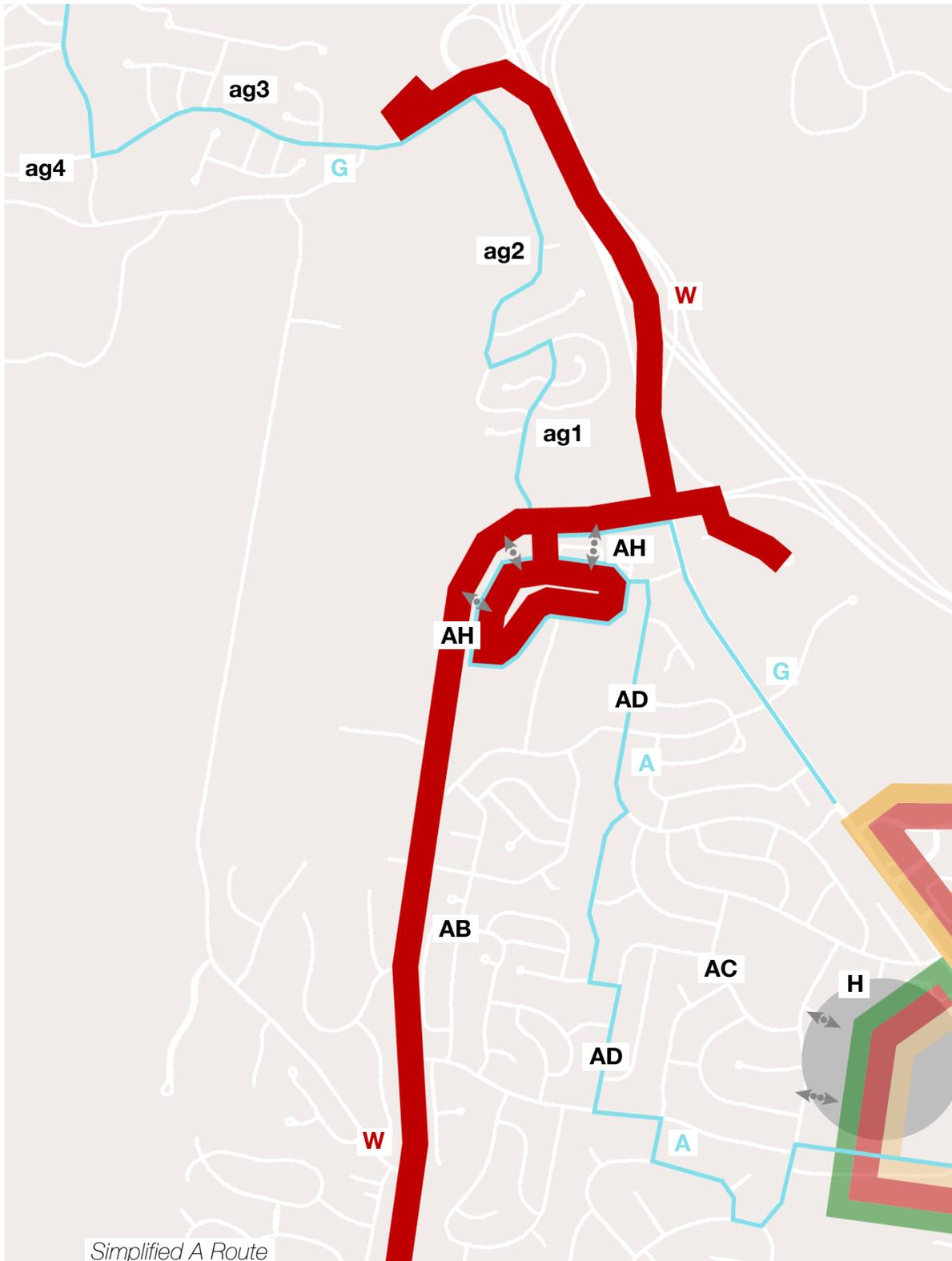
Remove the loop on the A route in favor of a central Park Forest bi-directional route.

EXISTING CONDITIONS

Loop services require most riders to travel out of their way in one direction or travel significantly farther to reach another stop heading in the correct direction.

Current peak-only routes closely parallel more frequent routes, not

¹⁰⁵ Centre Area Transportation Authority, "Assessment of Articulated Bus Utilization," 86.



Simplified A Route

servicing areas farther from those frequent routes as well.

ISSUES RESOLVED

The western side of the A loop in Park Forest is generally only one block from significantly more frequent W service [**AB**] and detours on the eastern side are near even more frequent N, NE, NV, and VN service [**AC**], so a single routing paralleling the eastern half of the loop without some detours [**AD**] still allows the entire neighborhood to be served. Even when the N corridor is moved to Wolf Ln and through Patton Crossing to the intersection of N Atherton St and Woodycrest St, expanded pedestrian and bike connections to Park Ln will allow for access to the corridor from nearby neighborhoods [**H**].

NEW ADVANTAGES

The majority of the loop on the B route can be simplified into a single bi-directional route [**AE**] when Belle Ave to Beacon Cir [**ae1**] can be navigated by bus.

The B route can serve Mt Nittany Middle School and its surrounding neighborhoods for the first time [**AF**] when Brandywine Dr between Scenery Dr and Mt Nittany Middle School [**af1**] can be navigated by bus.

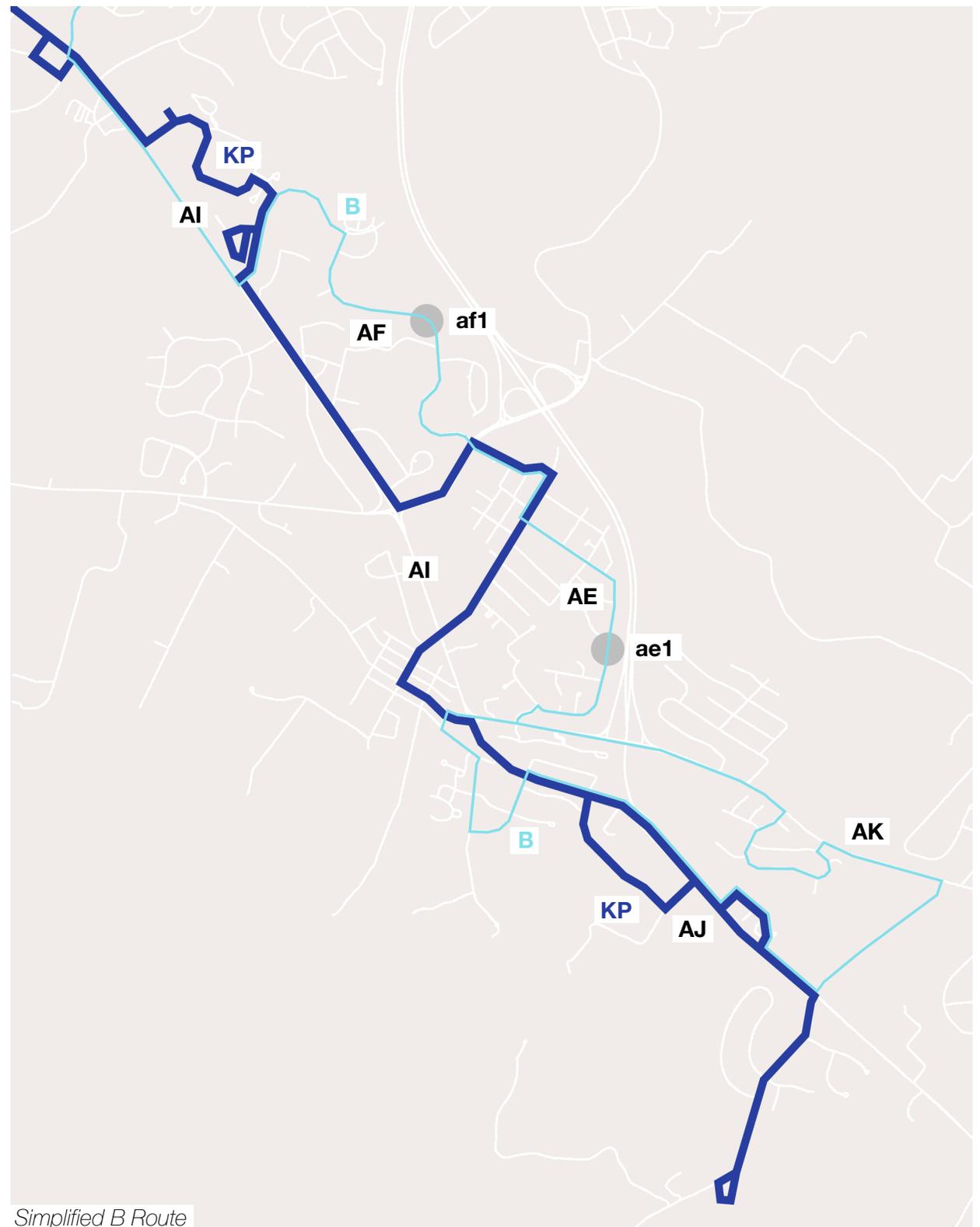
OPPORTUNITIES & POSSIBILITIES

Without a loop, the A route could be extended north to Carnegie Dr [**ag1**] and Ghaner Dr [**ag2**] and even Graysdale [**ag3**] and Gray's Woods [**ag4**], making G route service between Stormstown and campus faster.

Faster A route service from Galen Dr and Amblerwood Way to campus could allow the W route to serve the area exclusively via Valley Vista Dr, bringing 30 minute frequencies closer to possible [[see Increased Trunk Frequency](#)]. Expanded pedestrian and bike connections between Galen Dr and Valley Vista Dr [**AH**] would be necessary for access to the W corridor.

As development occurs along S Atherton St between University Dr and Boalsburg, the KP route should be straightened and constrained to Atherton St to serve that new development better and provide faster service to downtown and campus [**AI**].

The ultimate goal for the B route should be to make the loop as small as possible. Potentially, the KP route could serve US 322 [**AJ**] and the B route could exclusively serve Earlostown Rd [**AK**].



Simplified B Route

Other Notes

Stops on Blue Course Dr as close as possible to the Northland Center, on Vairo Blvd outside North Atherton Place, and near other commercial destinations on main roads will allow adjunct routes to better serve these commercial destinations without detouring through their parking lots.

An additional stop at Martin St and Blue Course Dr on the W and WE routes would allow riders to access The Park apartments without walking from the stops at the Northland Center, as many do today.

An additional stop on Toftrees Ave westbound outside The View and The Valley apartments would allow residents of those apartments to alight outbound HC buses before the bus takes a seven minute break at The Station.

Consider expanding the Loop and Link partnership to the K route to Cato Park because of the many ARL buildings on its route.