Memorandum

CLARKNEXSEN
301 College Street, Suite 300
Asheville, NC 28801

Project: Hendersonville High School

Date: 8-16-2016
Comm #: 5199.A
Purpose: Proposal review
To: John Mitchell
Subject: O'Cain Proposal review.

Dear Mr. Mitchell,

We have performed a comparison of the proposed solution from Mr. O'Cain. From our perspective this proposal closely resembles Option 2 presented to the School Board and the County Commissioners. While there is some validity to the proposal, a number of items are overlooked, incorrectly calculated, or absent to operate Hendersonville High School in a manner that meets or exceeds the Department of Public Instructions recommended guidelines.

Itemized below are our notes from the review of the proposal. The review consisted of two parts. First, a review of the proposed phasing and program. Secondly, as an appendix to this commentary, we have performed a mathematical evaluation to determine, as best as possible, an apples to apples comparison of the budgets. In fairness, we have had to make some judgement calls due to the lack of data provided and the depth of the investigation presented by Mr. O'Cain.

Review of the O'Cain Proposal:

Section 1: Schedule

New Gym & Vocational	6-17 thru 8-18	14 months of construction	28,000sf
Demo Old Gym and Voc	6-18 thru 8-18	Concurrent with wrap up of New Gym and Voc.	
New Classrooms and Café	8-18 thru 8-19	12 months of construction	72,500 sf **(need a minimum of 132,000 sf to match existing, the existing cafeteria and band room is within this footprint there would be a need for temporary facilities)**

Renovate Stillwell	6-19 thru 8-20	14 months of construction 2 concurrent total 12 month	**65,000 sf renovated space during renovation there is a need of 31,500 sf of temporary space**
Total duration	June 2017-August of 2020	38 months of construction	165,500

A. We found the duration of construction to be realistic, if the program requirements were accurate. Due to the inaccuracy and lack of understanding of the program the schedule is immaterial. For example, if the program accurately reflected the requirements, the duration of construction would have been extended due to the increase in building area.

Section 2: Program and Phasing Analysis

A. There is approximately 31,500 sf of space missing once phase 2 and phase 4 are completed (The existing buildings are approximately 132,000 sf, phase 2 and phase 4 build only 72,500 sf). How is the deficit going to be addressed during the renovation of Stillwell? Meaning there is not enough space to house the existing student population/programs within the new facilities during the renovation of Stillwell. Temporary accommodations would have to be made either by reducing the student population or with the use of modulars. This is not accommodated in the proposal.

B. Phase 4 appears to be built on the existing band and cafeteria space. Where are those students housed during the construction of these buildings? Band and the Cafeteria space require a specific environment not easily accommodated with temporary facilities. Subsequent to the document (Exhibit A) publication, Mr. O'cain presented an option to include the cafeteria as part of earlier phases. However, there has been no indication of the accommodations for the Band facilities.

C. We cannot determine how the capacity would be increased. The current approved program, housing 800/1000 students is approximately 161,500 sf. If there was an increase in student capacity then the core program components would have to increase as well, thus enlarging the square footage of the building(s). For example, the sketch (Exhibit A) indicates a student population of 1250 students, in order to house that many students, the core (as programmed for 1000 students) would have to increase by over 20%. This cost is not included in the O'Cain proposal and attempting to accommodate 1250 students within a core designed for 1000 would lead to overcrowding and poor student accommodations, similar to existing conditions.

D. The "Key elements" indicate that the auditorium size would be increased. The existing auditorium size is approximately 850 students. Without sizeable costs, we do not see a probable way to increase the size of the auditorium within the existing footprint.

E. Currently the Hendersonville Middle School has a capacity of 600 students. The proposal has more than double the capacity. It is unclear, if there would be a proposal to turn HHS into a magnet school. If not, where would the student body originate? The current population growth projected by the School system indicates a level to slight decline over the next 10 years.

F. The "Key Elements" indicate a double gymnasium. In order to accommodate a "double gym" and support space, the program size would have to be 39,200 sf. The "double gym" stated in the O'Cain proposal at 15,000 sf, would only accommodate a gym for 1000 and ½ of the necessary locker rooms. **The current program for the approved Option #3**, contains a main and auxiliary gym, along with all the necessary support spaces.

G. A project that involves 5 phases of construction has a greater risk factor than a project that would involve 2 phases of construction. The risk factor is influenced by the longer construction duration, possible escalations that are difficult to predict (refer to Exhibit E for escalation chart from DPI projects) the school's population intertwined with construction activities. Mr. O'Cain's proposal does not account for this due to a lack of contingency included in the budget numbers.

H. The proposed program does not correspond to the DPI baseline program or the approved current building program that is being proposed and reflects a lack of understanding of the importance of accommodating 21st Century learning environments.

I. The proposed layout of the facilities, with numerous buildings, present many challenges towards maintaining a safe school environment due to the number of entrances and possible access points. Critical to school safety is establishing clear boundaries and the ability to deter possible breaches.

Section 3: Budget Review

A. Comparisons of the budgets are very challenging. Only looking at square footage costs cannot formulate a true picture of what is required to successfully complete a project. The data provided indicates a significant a delta between high and low prices. Our recent experiences in WNC indicate the construction costs would be on the highest end of the spectrum. It is not uncommon for the eastern portion of the State to see lower costs associated with projects due to several factors, they include the following:

1. Many of the buildings are built on sites that are relatively flat in comparison to the site for the HHS.
2. Many of the facilities are built utilizing load bearing masonry in a single story fashion. We are challenged with weather extremes that make that type of construction difficult.
3. We are in Climate Zone 4A many of them are in Climate Zone 3A. Our zone requires additional insulating properties for the building envelope.
4. The subbase for WNC is relatively small and larger subcontractor packages require additional expense to bring them to the job site.
5. The cost of some materials, notably concrete, is considerably higher in WNC due to lack of competition.

B. The range in the cost of classrooms and renovation costs is concerning. While work can be performed and certain aspects of the project accomplished at those values, **the product at the completion will most certainly be a reflection of the dollars spent.**

C. In performing an apples to apples comparison of the budgets, we reflected on Option 2 presented earlier to the Board and compared that to the information presented by O'Cain. The range of costs presented are from $173/sf -$289/sf. Several key factors to consider include the following:

1. The option presented by Mr. O'Cain does not include the necessary modular units. Based on program needs, modulars over 32,500 sf would be required to support the current student body. If those costs are added to the construction values, there would be an increase of approximately $1,000,000. As we have pointed out on several occasions, the cost to install the modulars is largely based on the availability of the units on the open market.
2. Life Cycle cost should always be considered along with sustainability. Mechanical systems, in particular, fall into a category where cheaper upfront costs do not necessarily translate into a better investment.
3. Exterior envelope is another area where upfront cost in comparison to annual maintenance expense should be considered. Selection of cheaper first cost materials, such as synthetic stucco, will result in added maintenance and repair responsibilities.

D. There appears to be no escalation carried in any of the numbers presented. Stillwell costs presented at $200/sf in today's dollars would not purchase the same level of renovation of $200/sf 4 years from now or even 3 years from now. This would lead to a reduction in quality or the quantity of the renovation.

E. The budget presented does not include costs of surveying, geotechnical services, pre-con for CMR, air monitoring during demolition, special inspections.

F. The budget does not include the cost of permitting. The cost of the permits for $42,000,000 would be $294,294.

G. As indicated in Section 2-G, there is not contingency included in the calculations.

Attachments:

Exhibit A- O'Cain Sketch
Exhibit B, C- Brassfield and Metcon price review
Exhibit D- Cost comparison
Exhibit E- Escalation Chart from DPI projects
Exhibit F- Option 2 presented to Commission
Exhibit G- O'Cain Sketch overlay on site

EXHIBIT A

Costs: Buildings

$200/sf	13 million	Existing Stillwell	65000 #	includes auditorium
$200/sf	13 million	New Classrooms	65000 #	
$230/sf	3 million	New Vocational	13000 #	
$266/sf	2 million	New Cafeteria	7500 #	
$333/sf	5 million	New Gym.	15000 #	double national average
	5 million	Site Work	15 acres @ 300k	total sf 165,500
	1 million	Demo		
	2 million	Design Fees		
	2 million	FF&E		
	$46 million			

Schedule

	Start	Finish
Demo Boys		Spring 2017
New Gym & Voc	6-17	8-18
Demo Old Gym & Voc	6-18	8-18
New Classrooms & Cafe	8-18	8-19
Renovate Stillwell	6-19	8-20

Overall Duration: 38 Months

28,000

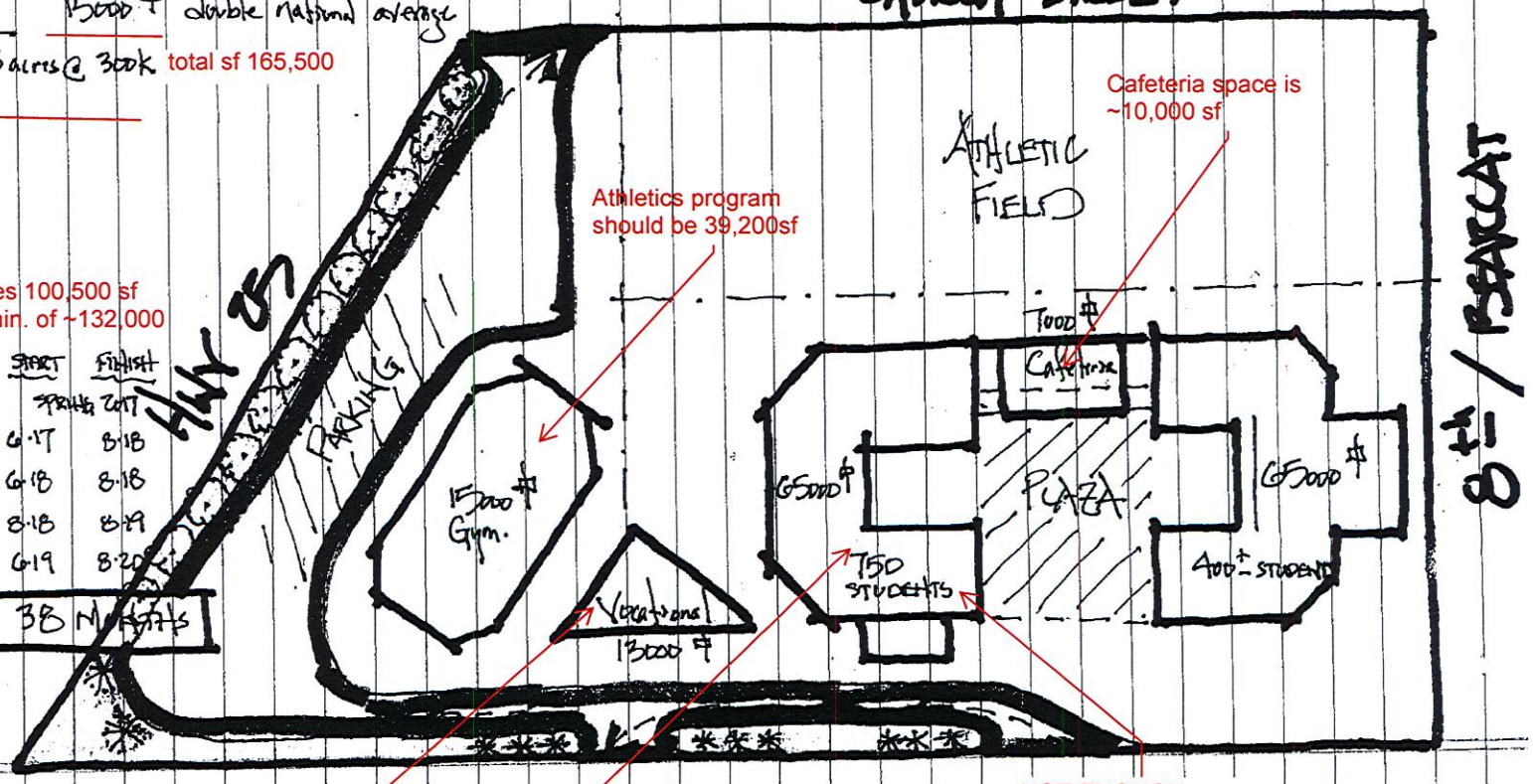
72,500

Provides 100,500 sf
need min. of ~132,000

Escalation is not being carried on any of the buildings

Key Elements

- Less expensive!
- Utilizes Stillwell Block
- No Student Trailers
- Double Gymnasium
- Safer & More Quiet!
- Increase Auditorium Size
- More Student Capacity



Athletics program should be 39,200sf

Cafeteria space is ~10,000 sf

vocational program is ~18,000

This location requires the cafeteria to be demo'd

NOT ENOUGH SPACE FOR STUDENTS NEED 100k

10 June 2016

NOTE: COMMENTS IN RED ARE FROM CN EVALUATION

EXHIBIT B

The following budget was established for the Hendersonville Alumni Association by Brasfield and Gorrie
B & G is one of the largest construction companies in the nation.
They have an annual volume of approximately 3 billion dollars.

HENDERSONVILLE HIGH SCHOOL BUDGET

June, 2016

Description	Quantity	Unit Cost Low	Unit Cost Medium	Unit Cost High	Cost Range Low	Cost Range Medium	Cost Range High
New Classrooms	65,000	175	200	225	11,375,000	13,000,000	14,625,000
Gymnasium	15,000	200	225	250	3,000,000	3,375,000	3,750,000
Renovate Stillwell	65,000	125	175	225	8,125,000	11,375,000	14,625,000
Cafeteria	7,000	250	275	300	1,750,000	1,925,000	2,100,000
Vocational Building	13,000	175	200	225	2,275,000	2,600,000	2,925,000
Sitework (acres)	15	300,000	400,000	500,000	4,500,000	6,000,000	7,500,000
SUBTOTAL:					**31,025,000**	**38,275,000**	**45,525,000**
Additional Considerations							
Demolition					800,000	1,000,000	1,200,000
Design Fees (6.0%)					1,861,500	2,296,500	2,731,500
Impact Fees					NIC	NIC	NIC
FF & E					2,000,000	2,000,000	2,000,000
Commissioning					380,000	400,000	420,000
Material testing					400,000	450,000	500,000
Contingency					2,500,000	3,000,000	3,500,000
TOTAL:					**38,966,500**	**47,421,500**	**55,876,500**

EXHIBIT C

The following budget was established for the Hendersonville Alumni Association by METCON
Metcon is a general contractor in the Carolinas. They specialize in school construction.
They have recently completed 3 large schools and have 3 more underway.

HENDERSONVILLE HIGH SCHOOL BUDGET

July, 2016

Description	Quantity	Low	Medium	High	Low	Medium	High
New Classrooms	65,000	145		165	9,430,000		10,725,000
Gymnasium	15,000	130		140	1,950,000		2,100,000
Renovate Stillwell	65,000	90		140	5,850,000		9,100,000
Cafeteria	7,000	195		205	1,365,000		1,435,000
Vocational Building	13,000	165		175	1,650,000		1,750,000
SUBTOTAL:					**20,245,000**	**22,677,500**	**25,110,000**
Additional Considerations							
Inflation					3,000,000		3,500,000
Sitework					4,500,000		5,500,000
Demolition					800,000		1,200,000
Design Fees (6.0%)					1,500,000		2,225,000
Impact Fees					NIC		NIC
FF & E					2,000,000		2,000,000
Contingency					3,000,000		4,000,000
Commissioning					400,000		400,000
Material testing					500,000		500,000
TOTAL:					**35,945,000**	**40,190,000**	**44,435,000**

EXHIBIT D

O'cain						Ocain	Brasfield Gore-low	Brasfield mid	Brasfield high	Metcon-low	Metcon-mid	Metcon-high	0 OPTION#2 4-11-16	Notes for O'Cain numbers:
Phase 1 - demo	1.0	LUMP SUM	@	$ 2,166,666.00		$ 2,166,666.00							$ 1,136,425.62	NOTE THAT I ASSUMED 1/2 OF DEMO NUMBER + 1/3 OF SITE WORK FOR OCAIN OPTION
Escalation-Assumed construction complete by 5/2017	8.0	month	@	.37% per month	2.960%	$ 64,133.31							$ 126,143.24	
													$ -	
Phase 2 - Construct the new Phys Ed and vocational	28,000	sf	@	$ 285.72		$ 8,000,160.00							$ 11,890,000.00	
													$ -	
Escalation-Assumed construction complete by 8/2018	24.0	month	@	.37% per month	8.880%	$ 710,414.21							$ 1,671,734.00	
													$ -	
Phase 3 - Demolish Gyms and Vocational	1	lump	@	$ 2,166,666.00		$ 2,166,666.00							$ 431,851.00	Remainder of demo and 1/3 site work
escalation on phase 3	22	months		.37% per month	8.1%	$ 176,366.61							$ 852,683.33	
Phase 3a-relocated to new gym and vocational													$ -	
													$ 11,302,530.00	
Phase4 - Construct New classrooms and cafe	72,500	sf	@	$ 206.00		$ 14,935,000.00							$ 8,538,522.00	
install modulars	32,000	sf	@	$ 31.25		$ 1,000,000.00								
Escalation-Assumed construction complete by 8/2019	36.0	month	@	.37% per month	13.320%	$ 2,434,633.94							$ 4,455,386.16	
													$ -	
Phase 4a - Relocate	2	months											$ -	
Phase 5-Renovate Stillwell	65,000	sf	@	$ 200.00		$ 13,000,000.00							$ 149,940.00	
Phase 6 - Remaining Sitework	1	lump	@	$ 1,666,666.00		$ 1,666,666.00							$ 750,000.00	
Escalation-Assumed construction complete by 8/2020	48.0	month	@	.37% per month	17.760%	$ 2,604,799.88							$ 236,414.24	
													$ -	
Sub total						$ 48,925,505.96	$ 31,825,000.00	$ 39,275,000.00	$ 46,725,000.00	$ 28,545,000.00		$ 35,310,000.00	$ 41,541,629.59	
Overhead and Profit				included in below	0.0%	$ -							$ 2,492,497.78	
Sub total						$ 48,925,505.96							$ 44,034,127.37	
Bonds and insurance				included in below	0.0%	$ -							$ 660,511.91	
Grand Total Construction costs						$ 48,925,505.96	$ 31,825,000.00	$ 39,275,000.00	$ 46,725,000.00	$ 28,545,000.00		$ 35,310,000.00	$ 44,694,639.28	
													$ -	
Owner Contingency					5.0%	$ 2,446,275.30	$ 1,591,250.00	$ 1,963,750.00	$ 2,336,250.00	$ 3,000,000.00		$ 3,000,000.00	$ 2,234,731.96	
Soft Costs(AE fees, CM pre-con fee, survey, permitting, geotech, special inspector, material testing agent, Air Monitoring etc.)					12.0%	$ 5,871,060.72	$ 3,819,000.00	$ 4,713,000.00	$ 5,607,000.00	$ 3,425,400.00		$ 4,237,200.00	$ 5,363,356.71	
Commissioning agent					1.0%	$ 489,255.06	$ 380,000.00	$ 400,000.00	$ 420,000.00	$ 400,000.00		$ 400,000.00	$ 446,946.39	
Furniture, fixture, equipment	165,500	sf	@	$ 12.00		$ 1,986,000.00	$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00		$ 2,000,000.00	$ 1,292,000.00	
Technology/ Equipment						$ -							$ 150,000.00	
Total Project costs						$ 59,718,097.03	$ 39,615,250.00	$ 48,351,750.00	$ 57,088,250.00	$ 37,370,400.00	$ -	$ 44,947,200.00	$ 54,181,674.35	

EXHIBIT D

O'cain						
						Ocain
Phase 1 - demo	**1.0**	LUMP SUM	@	$ 2,166,666.00		$ 2,166,666.00
Escalation-Assumed construction complete by 5/2017	8.0	month	@	.37% per month	2.960%	$ 64,133.31
Phase 2 - Construct the new Phys Ed and vocational	**28,000**	sf	@	$ 285.72		$ 8,000,160.00
Escalation-Assumed construction complete by 8/2018	24.0	month	@	.37% per month	8.880%	$ 710,414.21
Phase 3 - Demolish Gyms and Vocational	**1**	lump	@	$ 2,166,666.00		$ 2,166,666.00
escalation on phase 3	**22**	months		.37% per month	8.1%	$ 176,366.61
Phase 3a-relocated to new gym and vocational						
Phase4 - Construct New classrooms and café	**72,500**	sf	@	$ 206.00		$ 14,935,000.00
install modulars	**32,000**	sf	@	$ 31.25		$ 1,000,000.00
Escalation-Assumed construction complete by 8/2019	36.0	month	@	.37% per month	13.320%	$ 2,434,633.94
Phase 4a - Relocate	**2**	months				
Phase 5-Renovate Stillwell	**65,000**	sf	@	$ 200.00		$ 13,000,000.00
Phase 6 - Remaining Sitework	1	lump	@	$ 1,666,666.00		$ 1,666,666.00
Escalation-Assumed construction complete by 8/2020	48.0	month	@	.37% per month	17.760%	$ 2,604,799.88
Sub total						$ 48,925,505.96
Overhead and Profit				included in below	0.0%	$ -
Sub total						$ 48,925,505.96
Bonds and insurance				included in below	0.0%	$ -
Grand Total Construction costs						$ 48,925,505.96
Owner Contingency					5.0%	$ 2,446,275.30
Soft Costs(AE fees, CM pre-con fee, survey, permitting, geotech, special inspector, material testing agent, Air Monitoring etc.)					12.0%	$ 5,871,060.72
Commissioning agent					1.0%	$ 489,255.06
Furniture, fixture, equipment	165,500	sf	@	$ 12.00		$ 1,986,000.00
Technology/ Equipment						$ -
Total Project costs						$ 59,718,097.03

EXHIBIT D

Brasfield Gore-low	Brasfield mid	Brasfield high	Metcon-low	Metcon-mid	Metcon-high	OPTION#2 4-11-16
						$ 1,136,425.62
						$ 126,143.24
						$ -
						$ 11,890,000.00
						$ -
						$ 1,671,734.00
						$ -
						$ 431,851.00
						$ 852,683.33
						$ -
						$ 11,302,530.00
						$ 8,538,522.00
						$ 4,455,386.16
						$ -
						$ -
						$ 149,940.00
						$ 750,000.00
						$ 236,414.24
						$ -
$ 31,825,000.00	$ 39,275,000.00	$ 46,725,000.00	$ 28,545,000.00		$ 35,310,000.00	$ 41,541,629.59
						$ 2,492,497.78
						$ 44,034,127.37
						$ 660,511.91
$ 31,825,000.00	$ 39,275,000.00	$ 46,725,000.00	$ 28,545,000.00		$ 35,310,000.00	$ 44,694,639.28
						$ -
$ 1,591,250.00	$ 1,963,750.00	$ 2,336,250.00	$ 3,000,000.00		$ 3,000,000.00	$ 2,234,731.96
$ 3,819,000.00	$ 4,713,000.00	$ 5,607,000.00	$ 3,425,400.00		$ 4,237,200.00	$ 5,363,356.71
$ 380,000.00	$ 400,000.00	$ 420,000.00	$ 400,000.00		$ 400,000.00	$ 446,946.39
$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00	$ 2,000,000.00		$ 2,000,000.00	$ 1,292,000.00
						$ 150,000.00
$ 39,615,250.00	$ 48,351,750.00	$ 57,088,250.00	$ 37,370,400.00	$ -	$ 44,947,200.00	$ 54,181,674.35

EXHIBIT E

Avg. Cost of All School Construction in 2009 ---$127.92*
Avg. Cost of All School Construction in 2014 --- $203.00*
Avg. Cost of All School Construction in 2018--- $????

Represents an increase of 60% increase in 5 years, 12% per year, or $75.00/sf cost increase on average

*Information obtained from NCDPI

EXHIBIT E

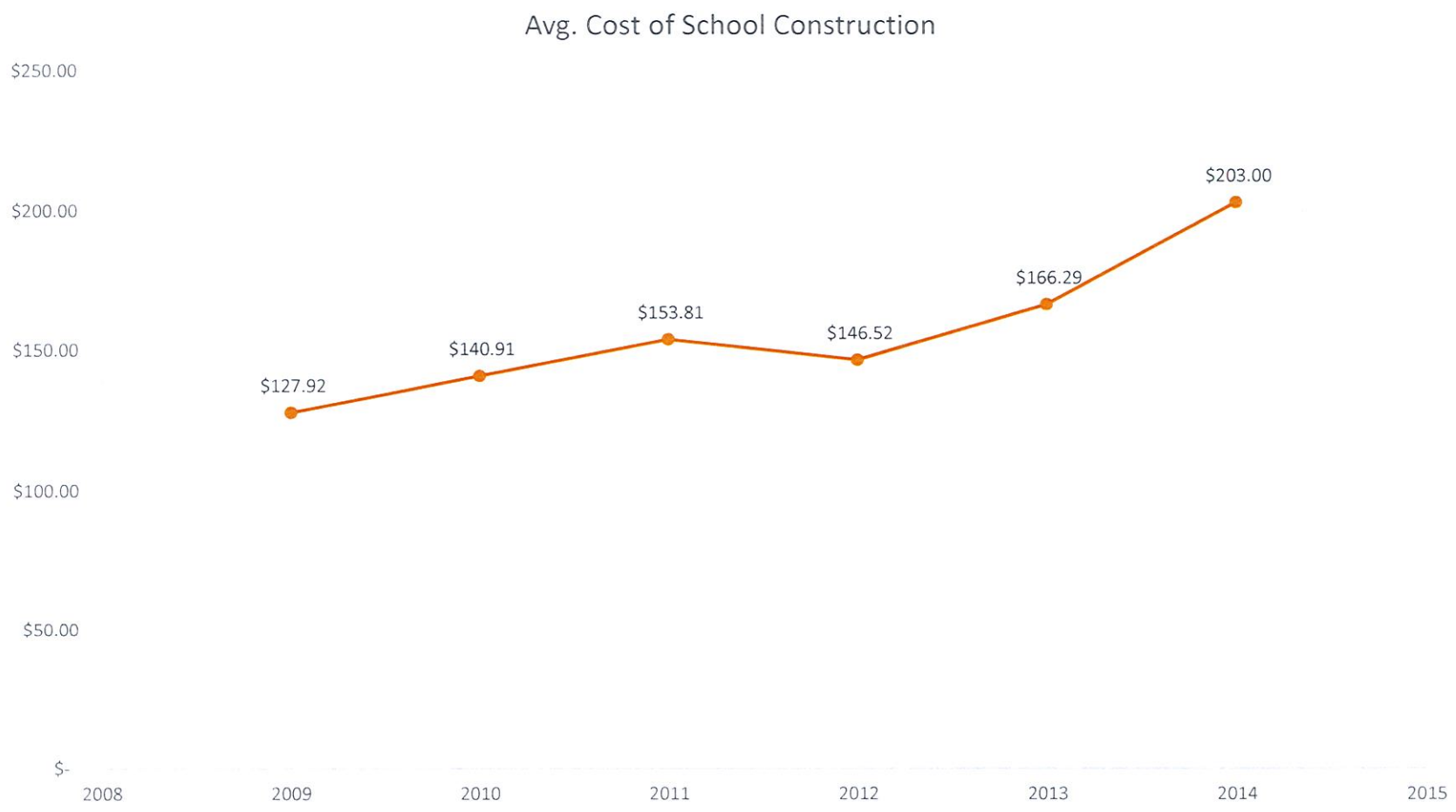
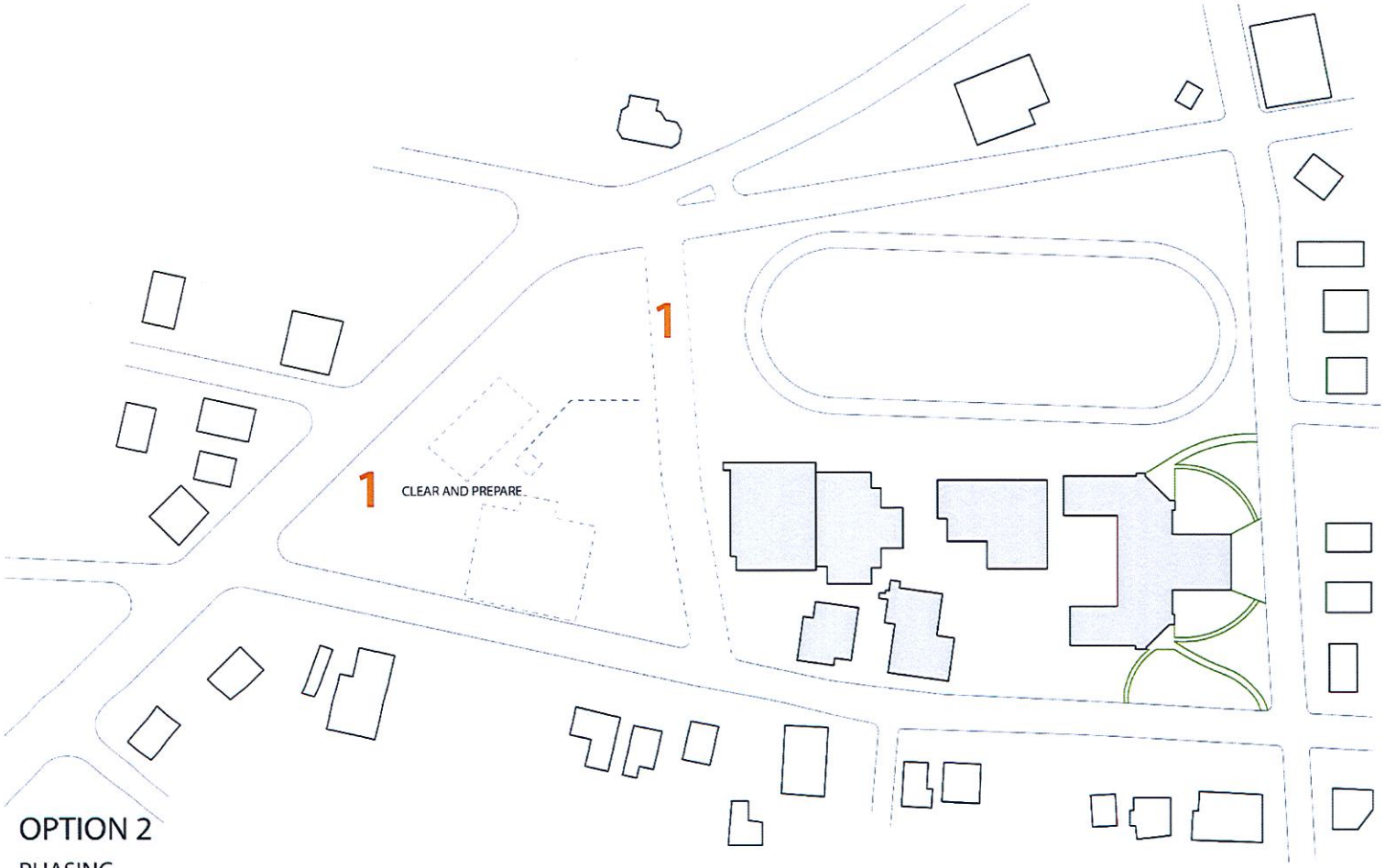

Avg. Cost of School Construction
$250.00
$200.00
$150.00
$100.00
$50.00
$-
2008
2009
2010
2011
2012
2013
2014
2015
$127.92
$140.91
$153.81
$146.52
$166.29
$203.00

EXHIBIT E

PROJECTED ESCALATION
Total Project Cost
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
Year Construction Completed
$50,402,258
$52,670,360
$55,040,526
$57,517,350
$60,105,631
$62,810,384
$65,636,851
$24,751,161
$25,864,964
$27,028,887
$28,245,187
$29,516,220
$30,844,450
$32,232,451
$33,682,911
$15,725,184
$16,432,817
$17,172,294
$17,945,047
$18,752,574
$19,596,440
$20,478,280
$21,399,803
$22,362,794
Edneyville Elementary
Hendersonville High - Option 3
Early College and Career Academy

EXHIBIT F -OPTION 2
PRESENTED BY CN

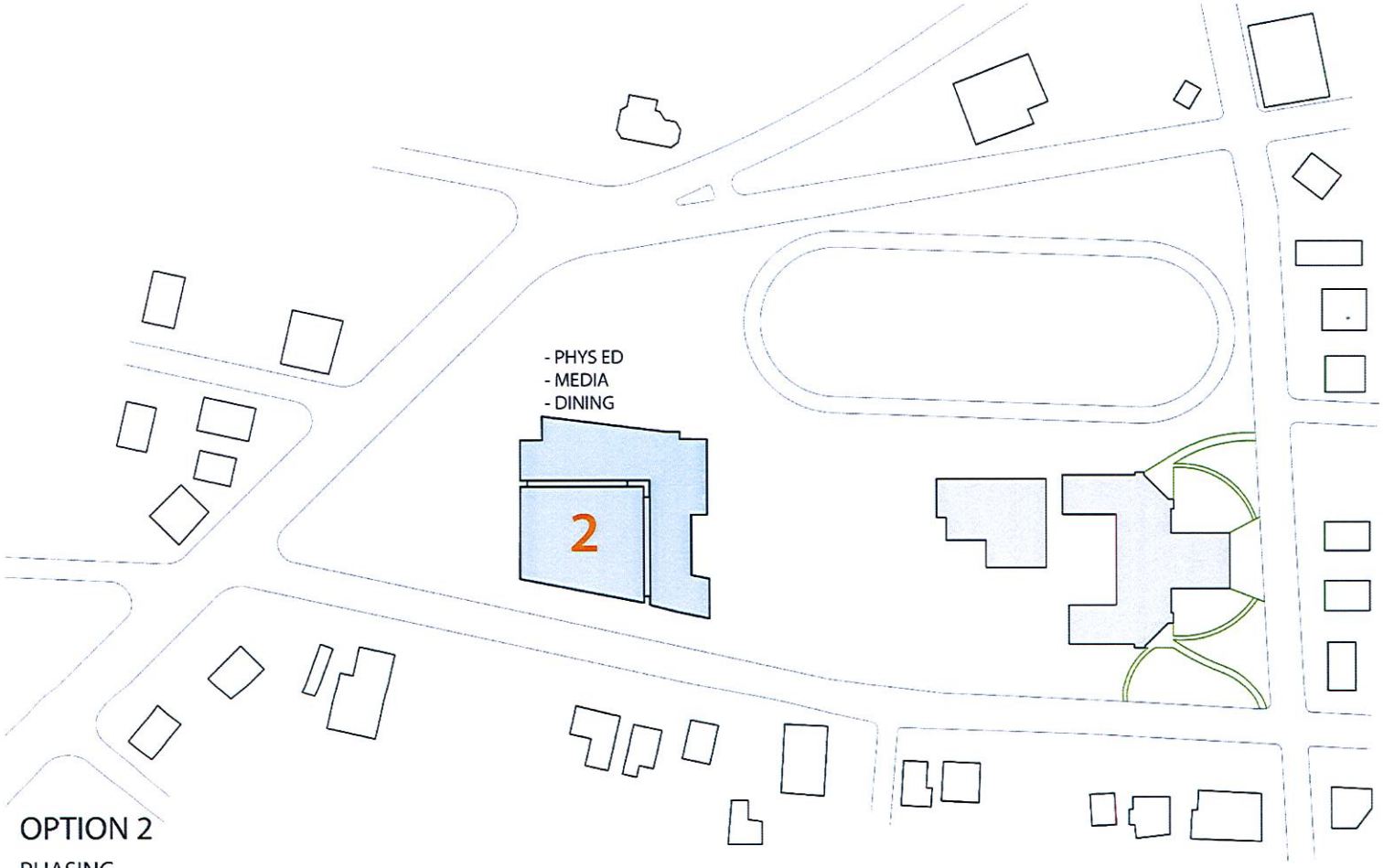


OPTION 2

PHASING

1 PREPARE THE NORTH SITE 3 MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

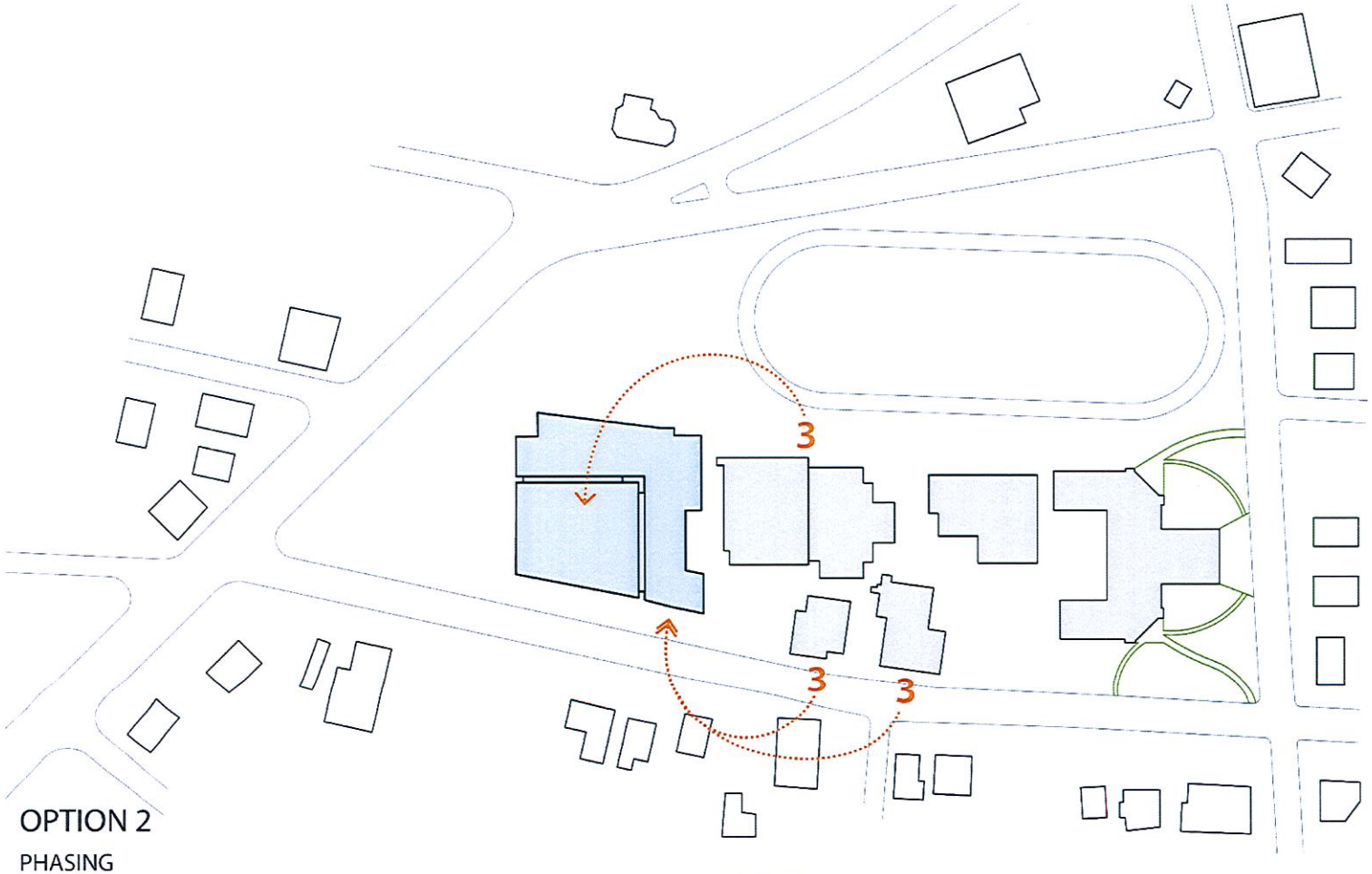


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2	BUILD	17	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

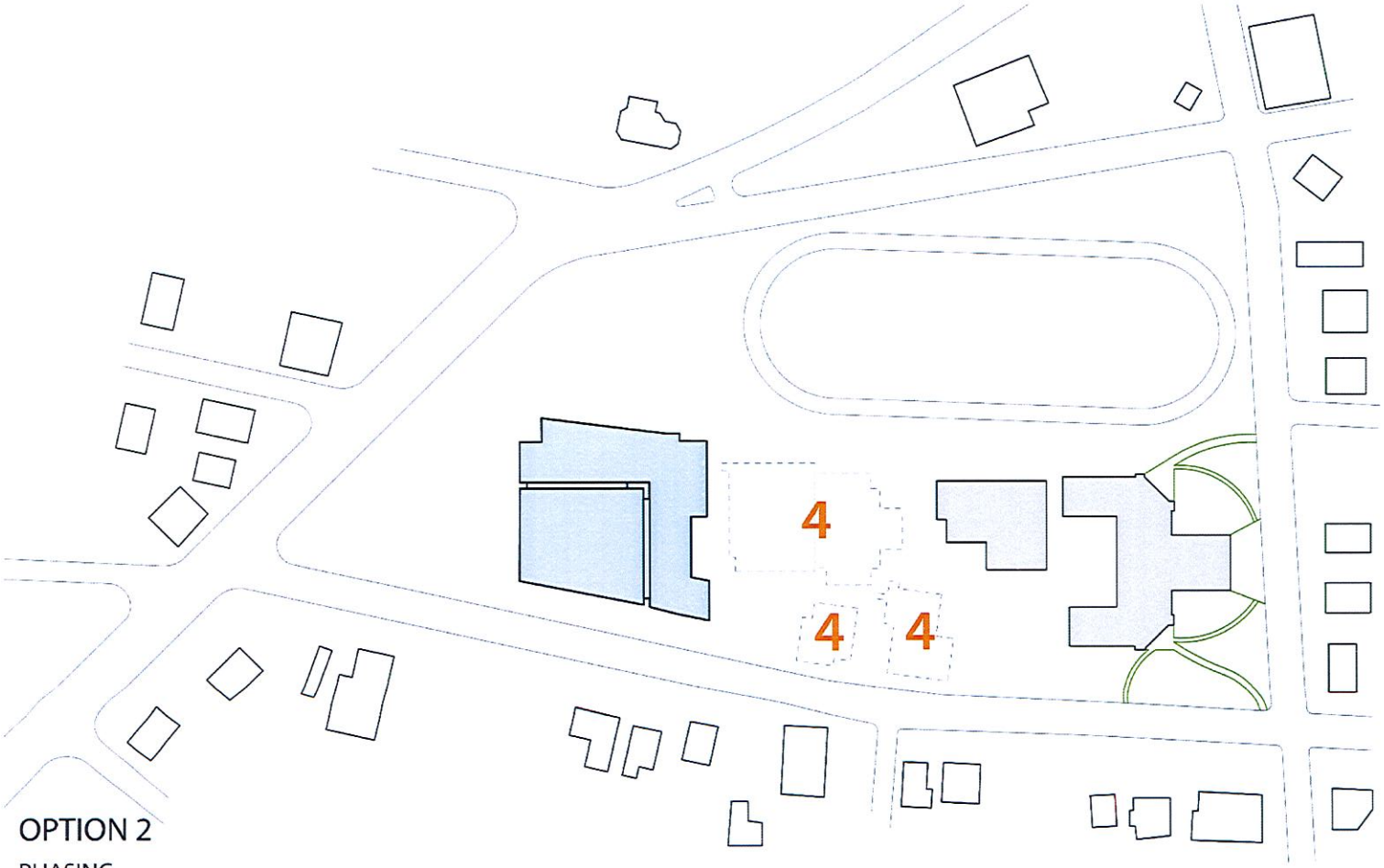


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

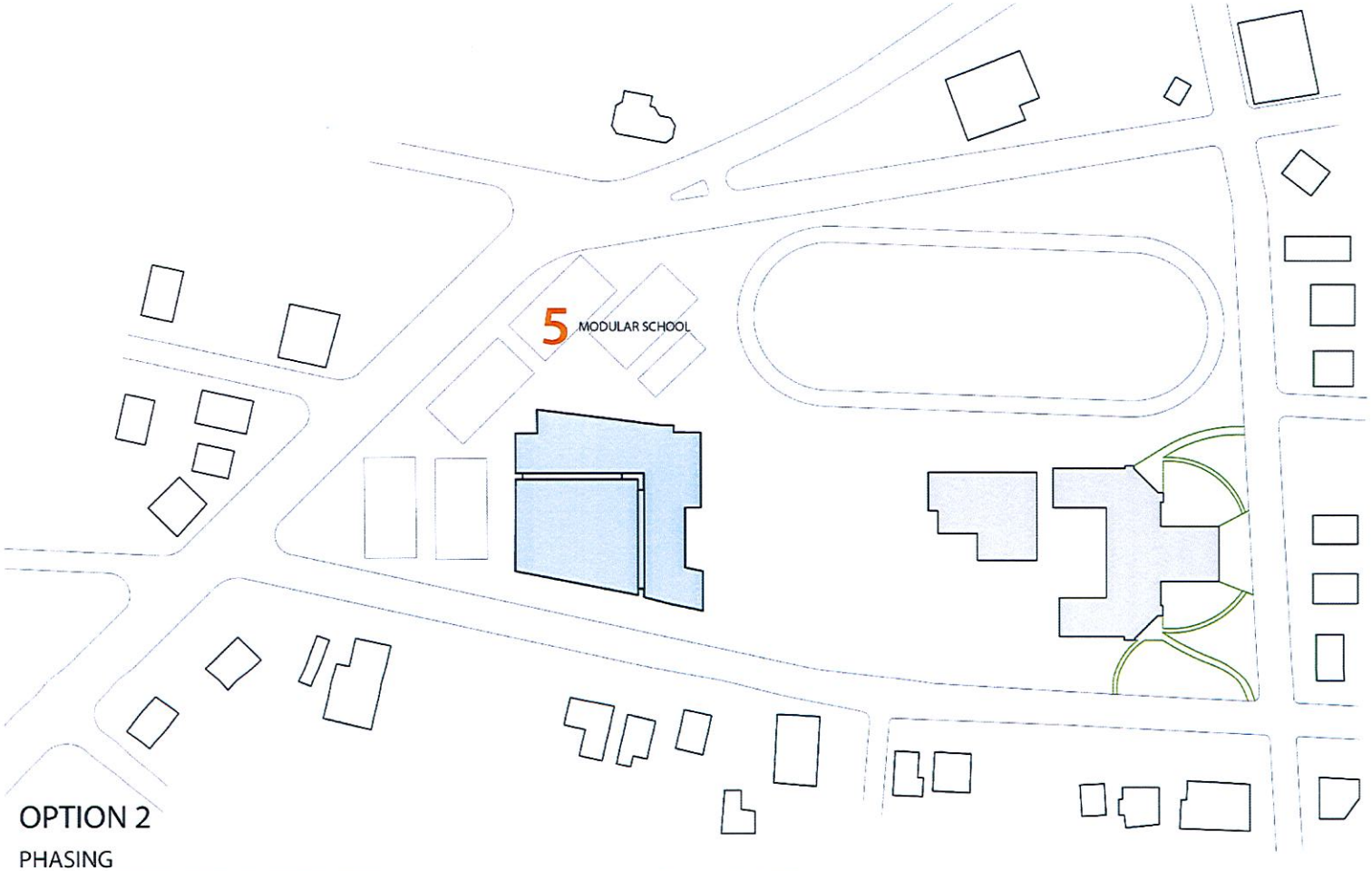


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4	DEMOLISH	21	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

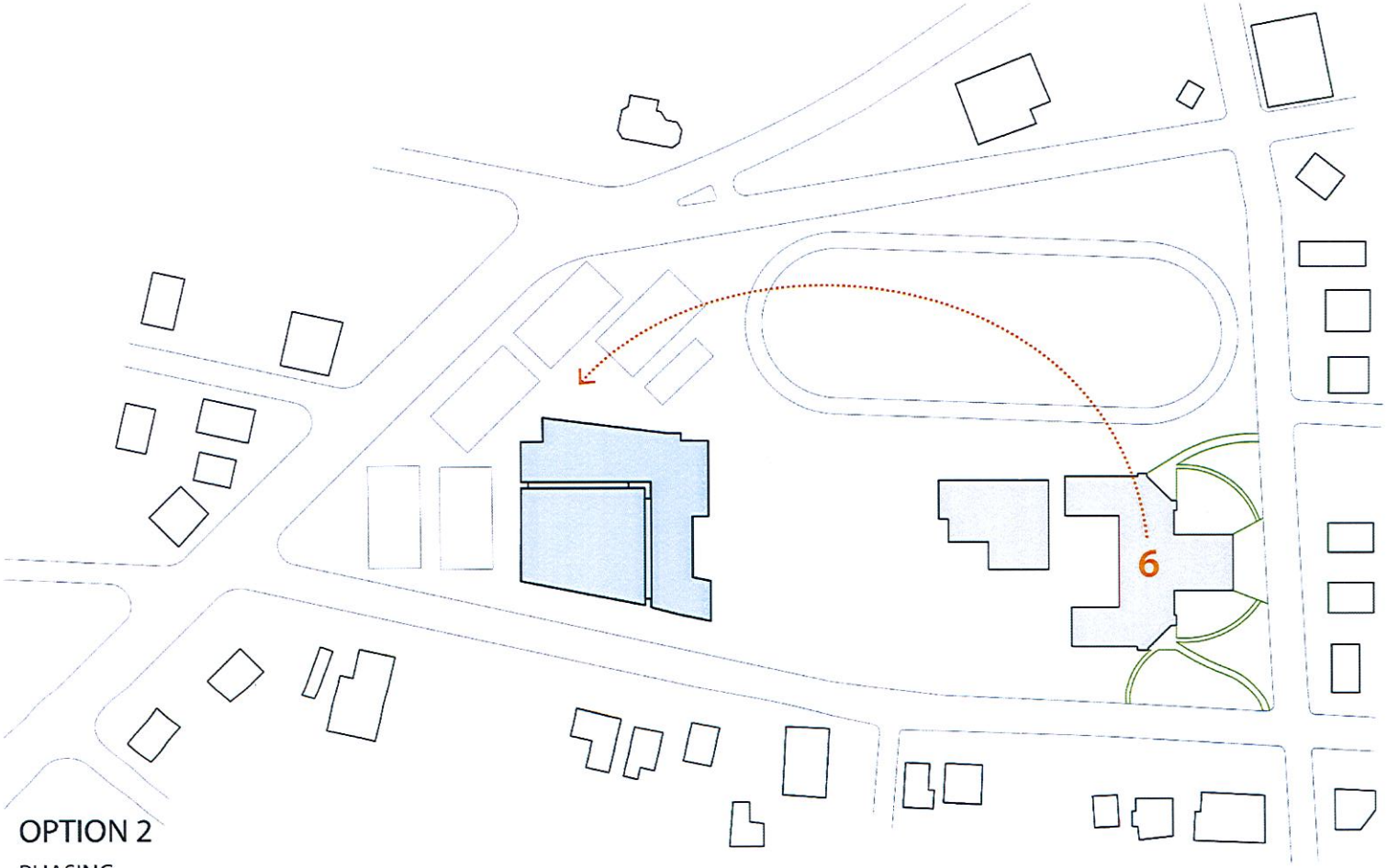


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5	DEMOLISH, INSTALL	21	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

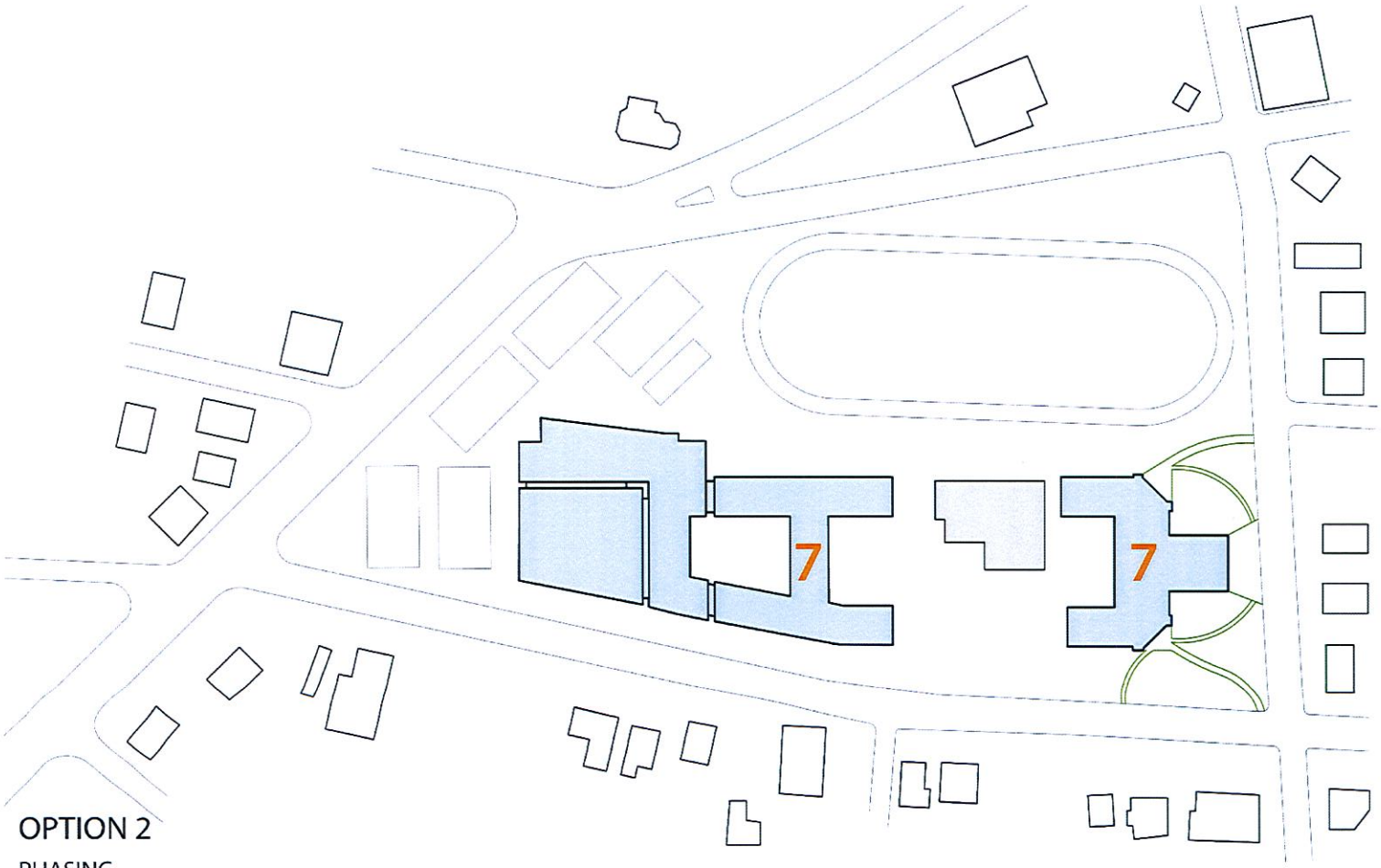


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5, 6	DEMOLISH, INSTALL, RELOCATE	21	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

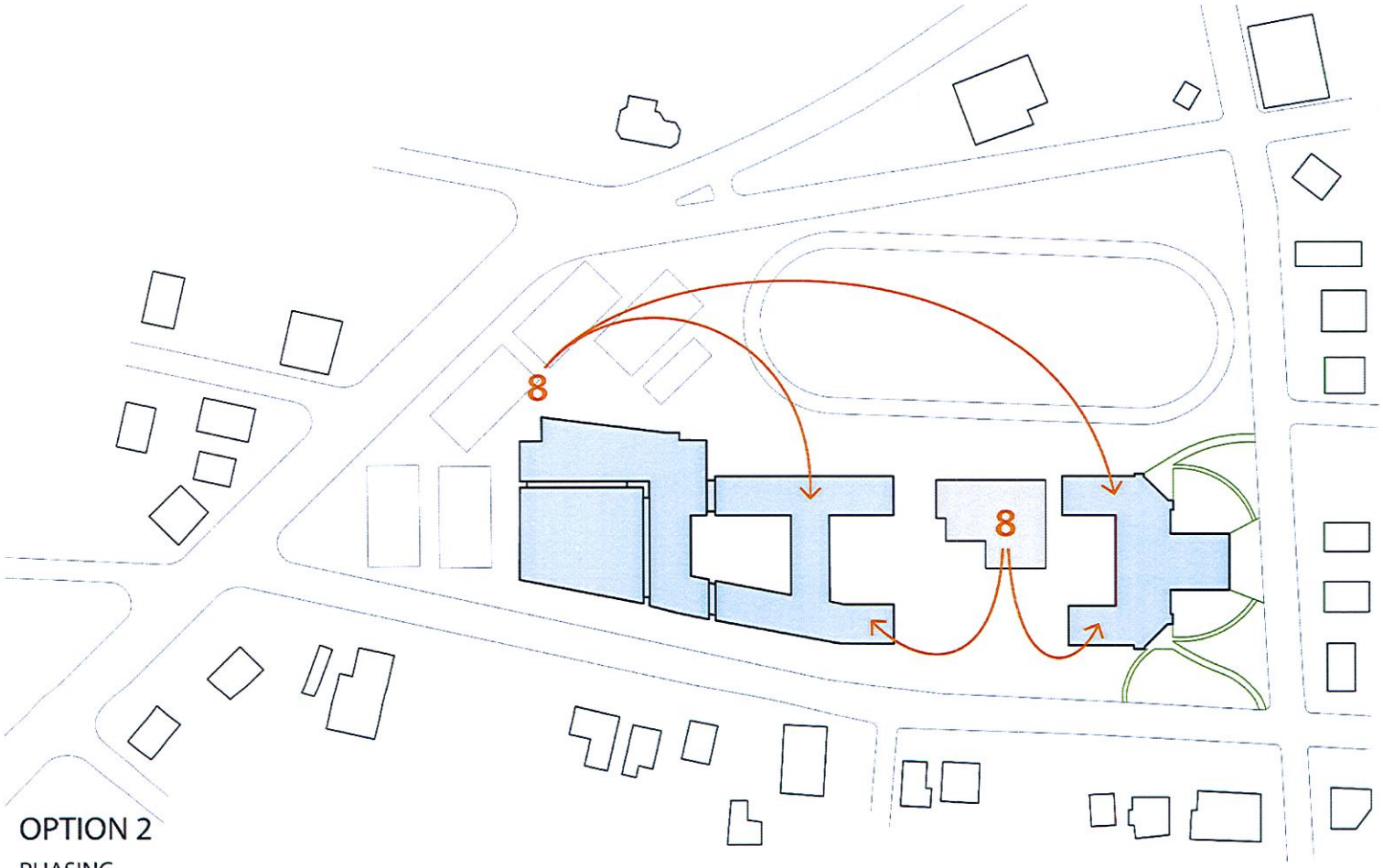


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5, 6, 7	DEMOLISH, INSTALL, RELOCATE, BUILD + RENOVATE	21	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

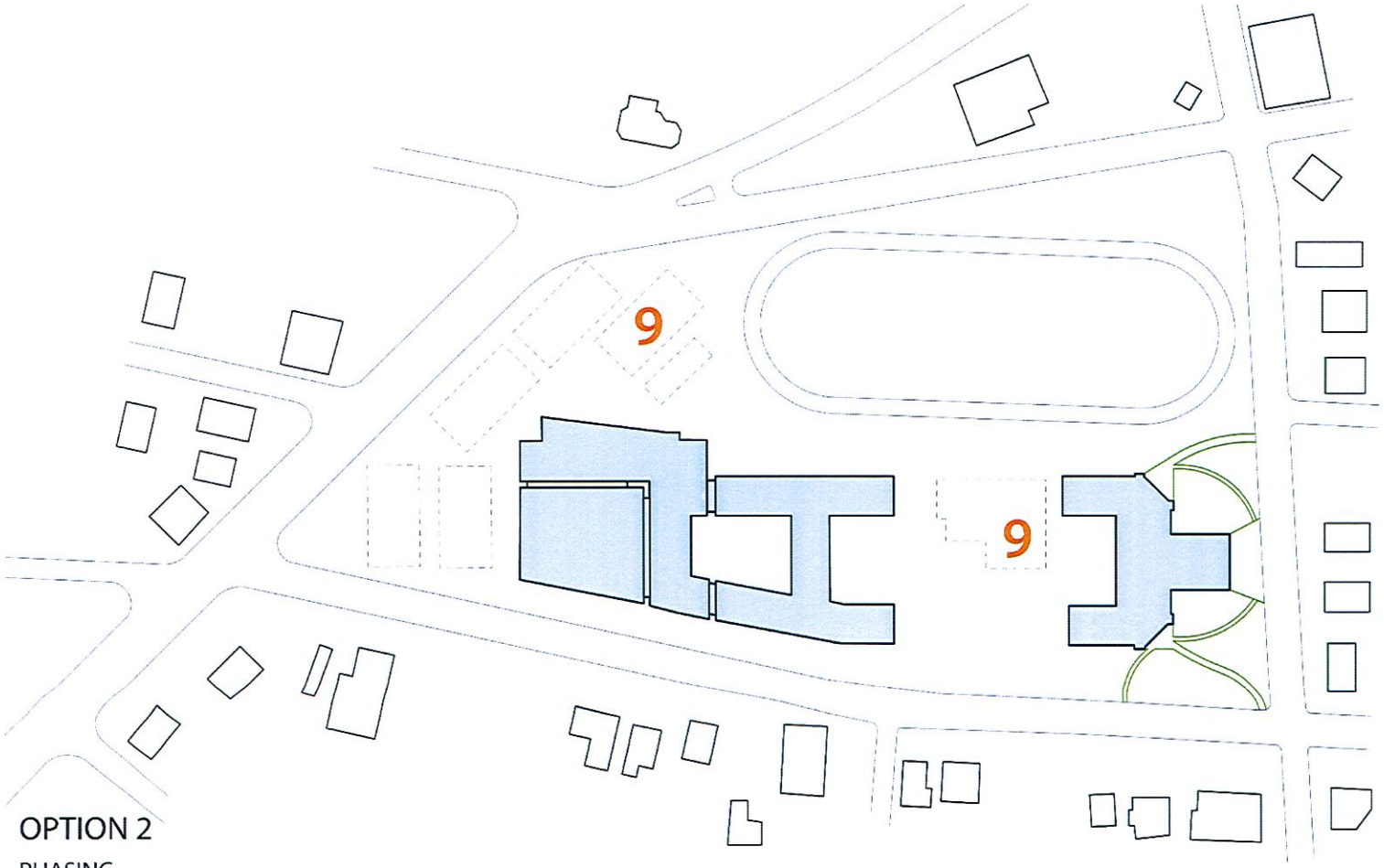


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5, 6, 7	DEMOLISH, INSTALL, RELOCATE, BUILD + RENOVATE	21	MONTHS
8	RELOCATE	6	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

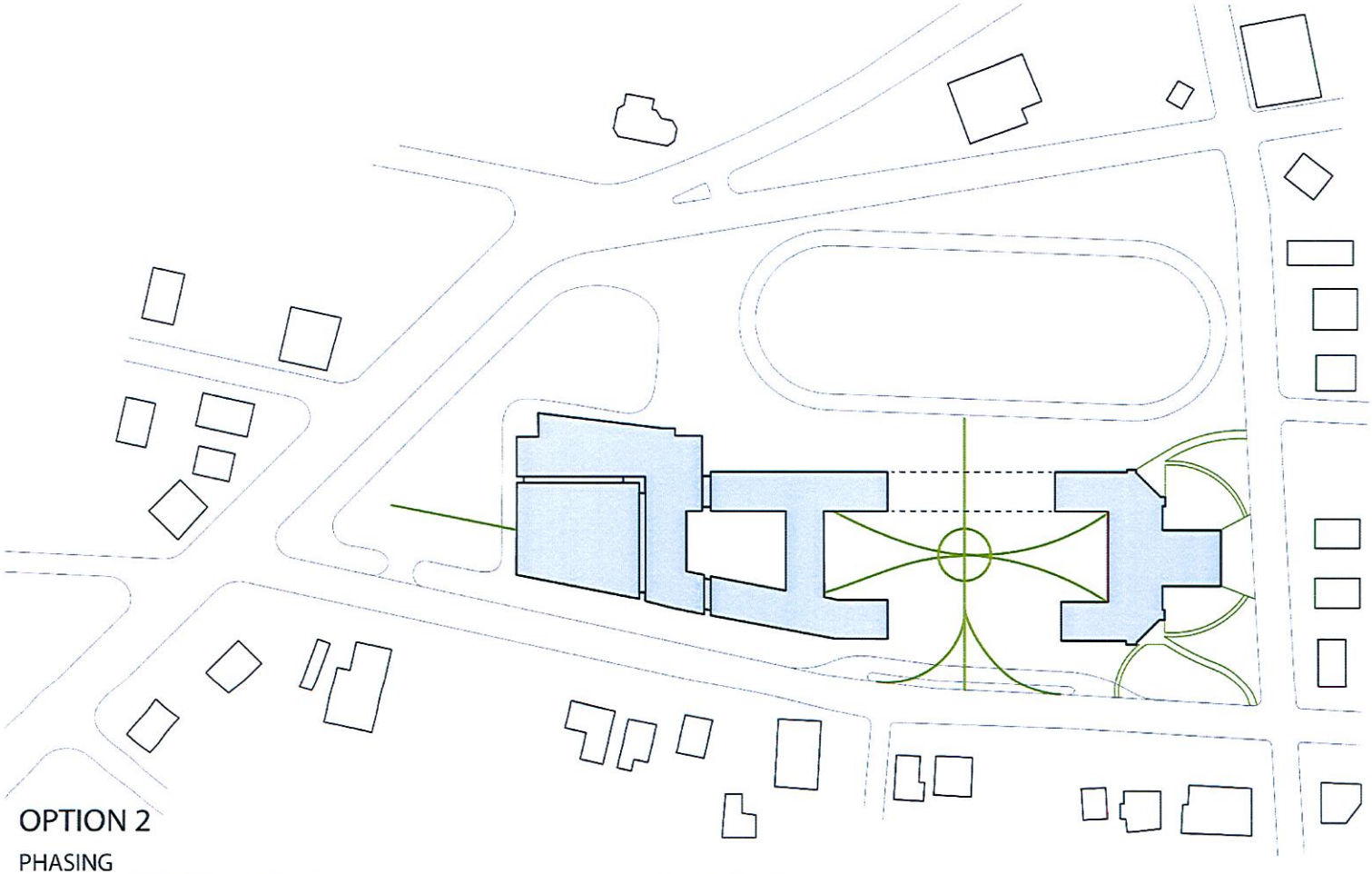


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5, 6, 7	DEMOLISH, INSTALL, RELOCATE, BUILD + RENOVATE	21	MONTHS
8, 9	RELOCATE, DEMOLISH	6	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN

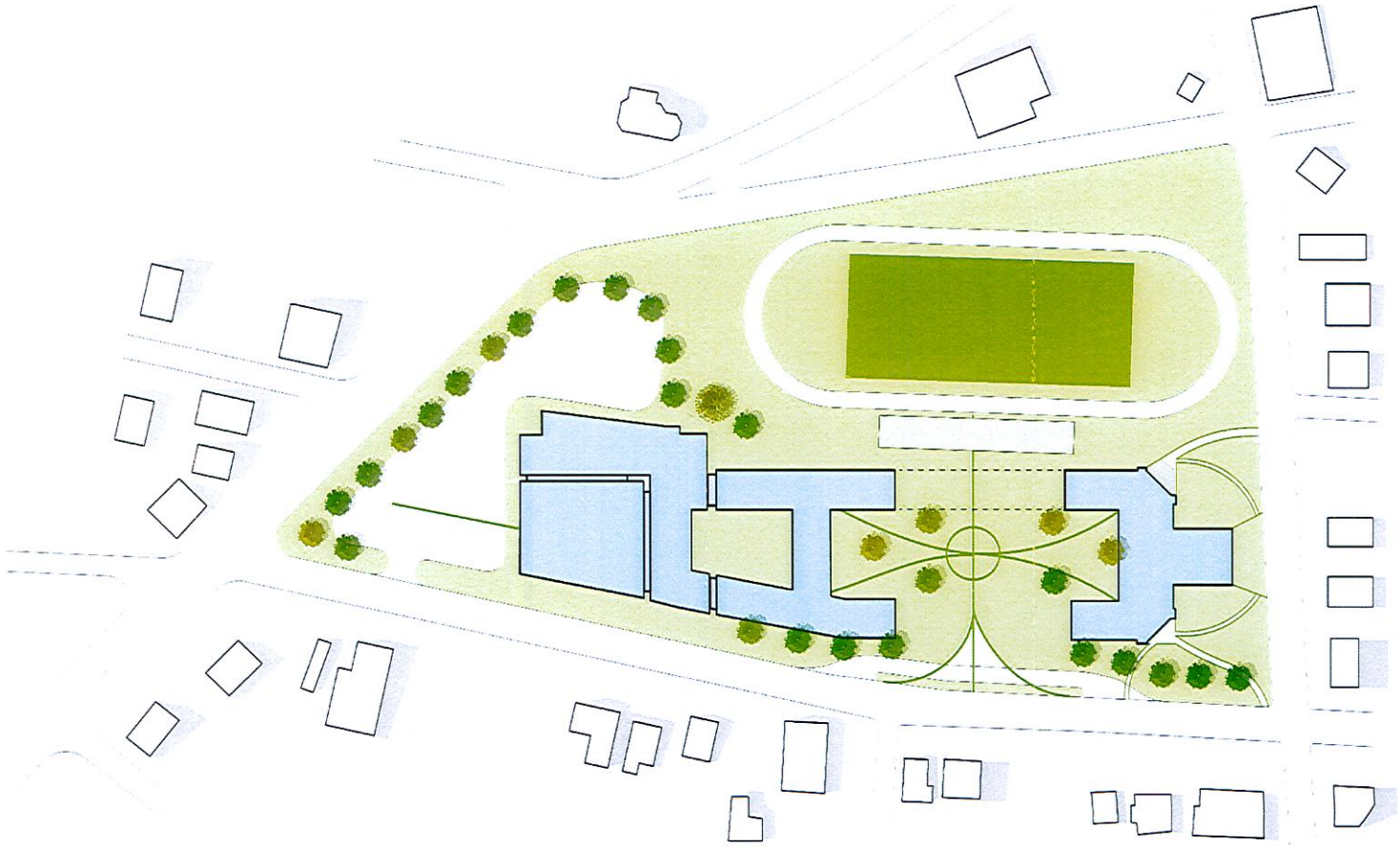


OPTION 2

PHASING

1	PREPARE THE NORTH SITE	3	MONTHS
2,3	BUILD, RELOCATE	17	MONTHS
4, 5, 6, 7	DEMOLISH, INSTALL, RELOCATE, BUILD + RENOVATE	21	MONTHS
8, 9, 10	RELOCATE, DEMOLISH, SITEWORK	6	MONTHS

EXHIBIT F -OPTION 2
PRESENTED BY CN



OPTION 2

INCORPORATE EXISTING	GYMNASIUM ON CAMPUS	# NEW BLDG. PHASES	LENGTH CONSTRUCTION	MODULAR VILLAGE
Yes	Throughout	2	47 Months (1/2021)	Yes, for 21 months

EXHIBIT G

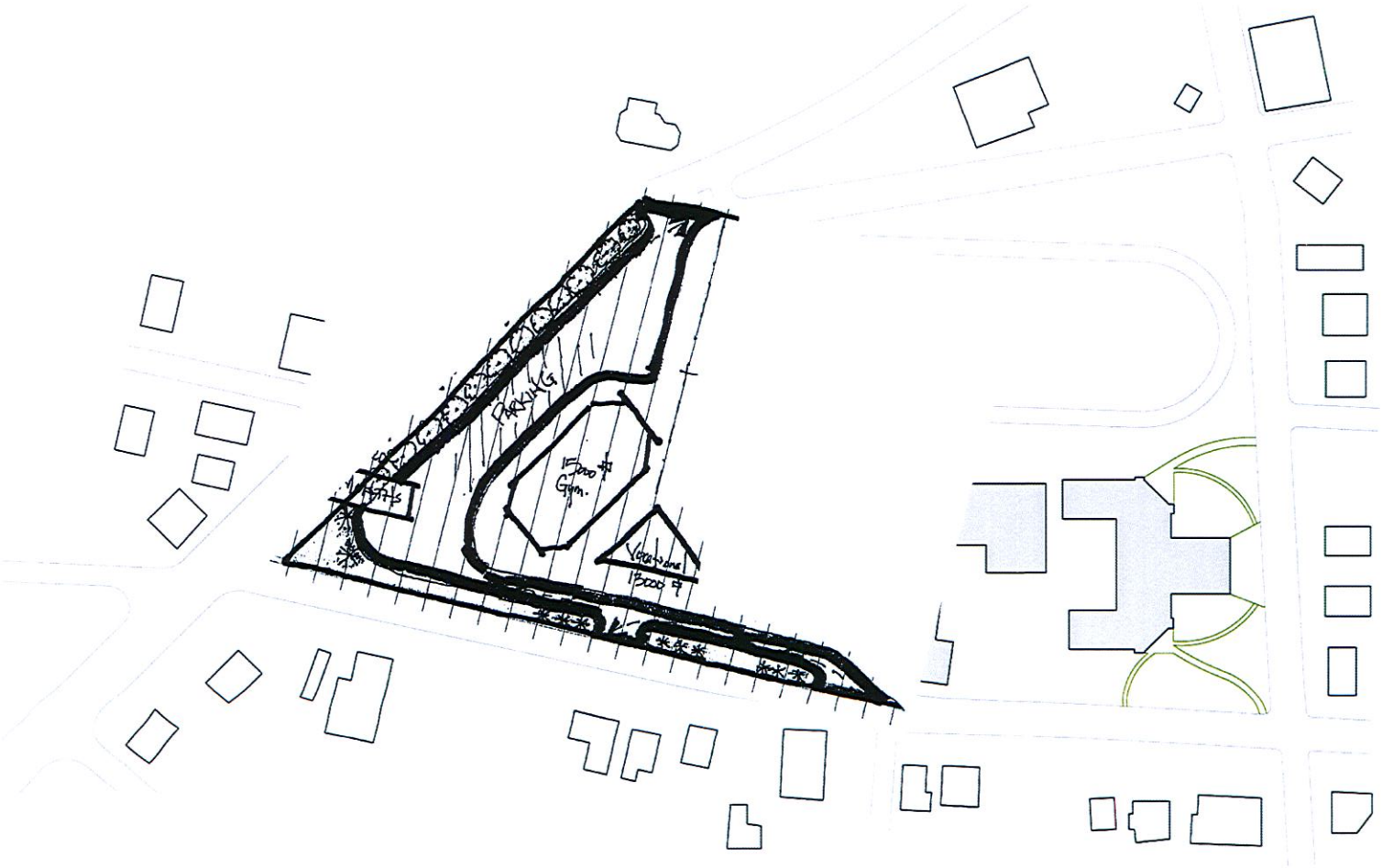


EXHIBIT G

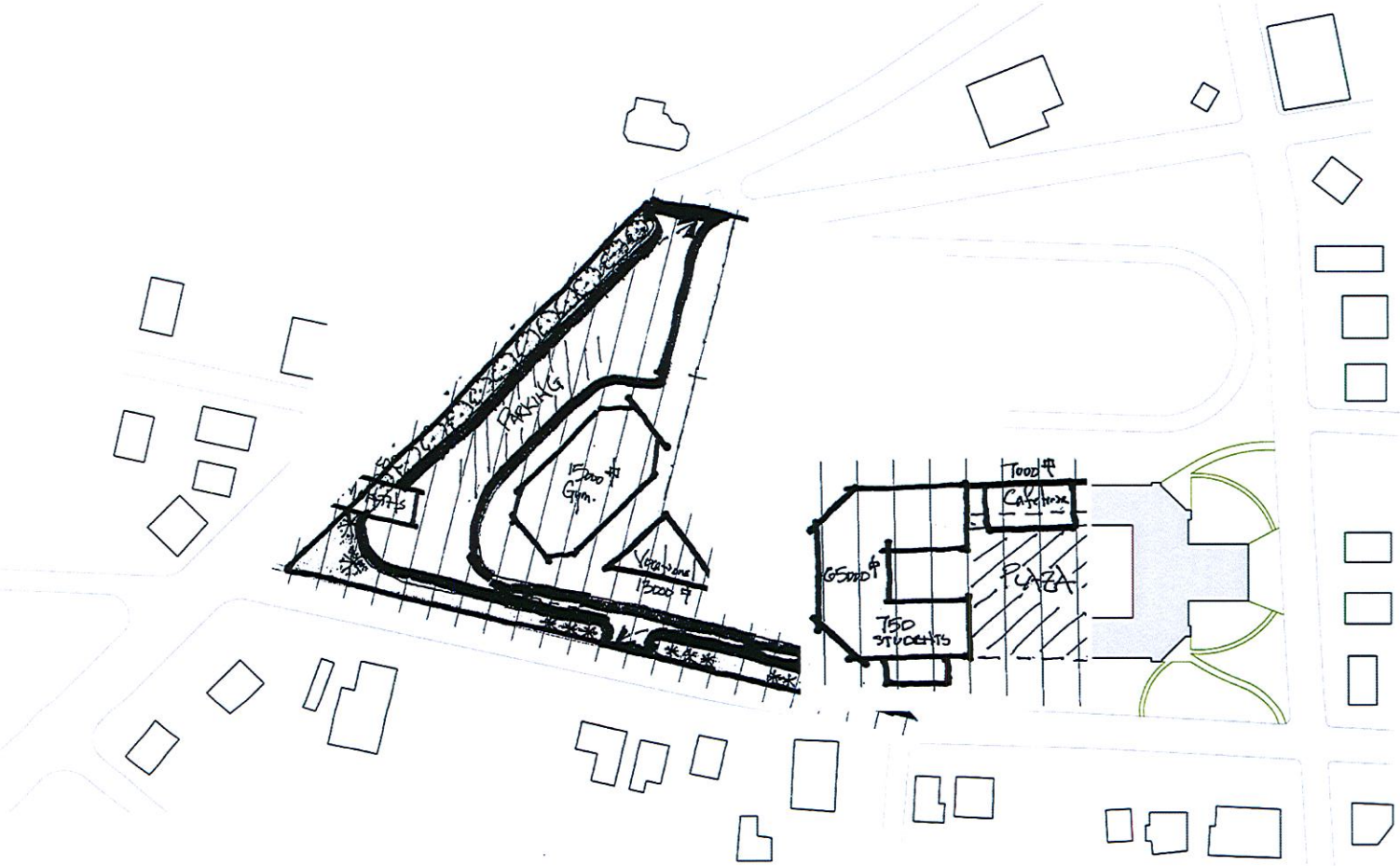
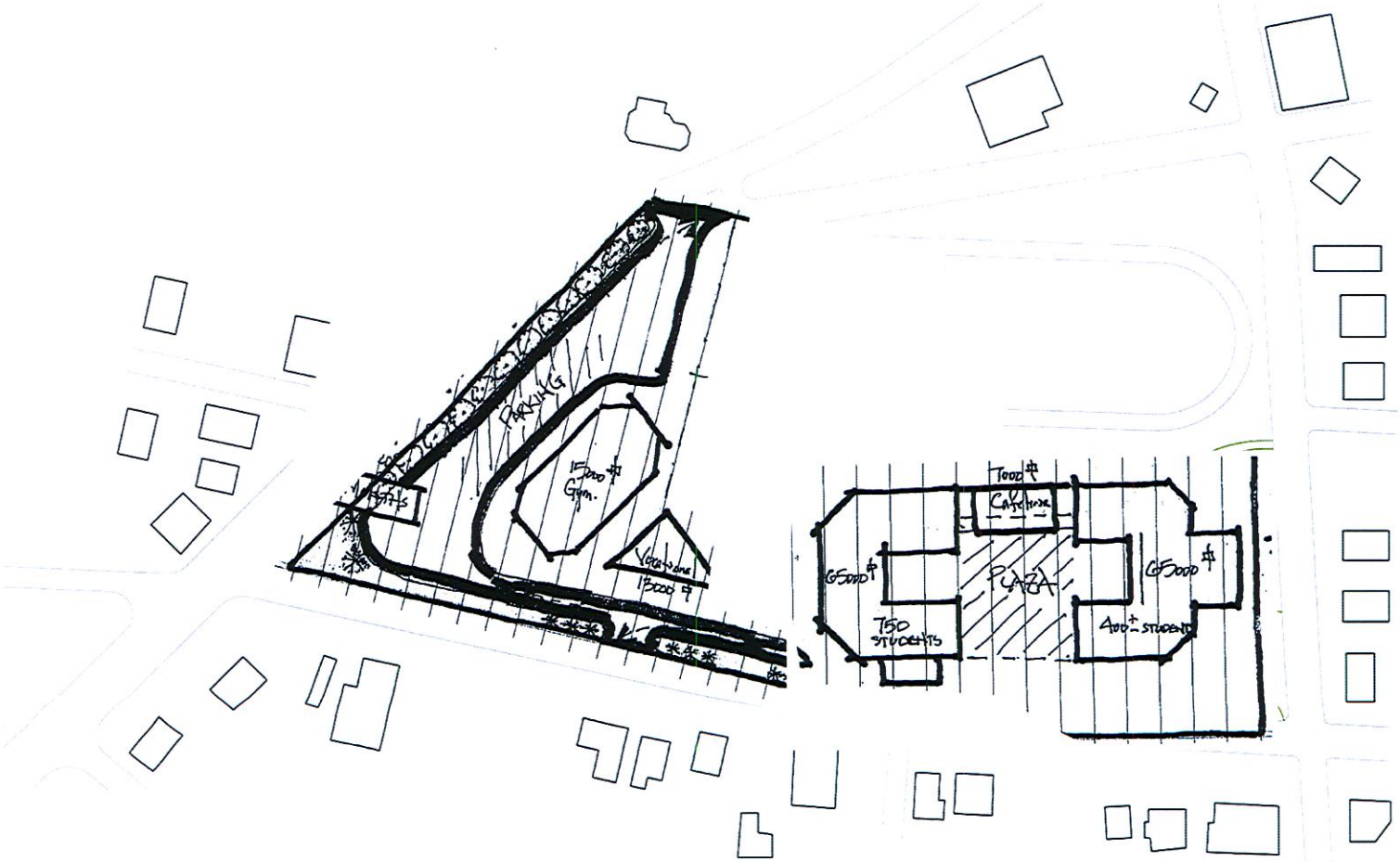

PARKING
15000 ft
Gym.
15000 ft
7000 ft
CAFETERIA
PLAZA
150 STUDENTS

EXHIBIT G


PARKING
15000 ±
Gym.
Yoga zone
13000 ±
7000 ±
Cafeteria
PLAZA
6500 ±
6500 ±
750
STUDENTS
400 ± STUDENTS