FINAL

Woodland Hills Elementary School
Traffic Impact Study

Corrected Michael's Landing Plat 1, Outlot X

December 28, 2011

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Executive Summary

The City of West Des Moines has analyzed potential traffic impacts associated with the development of the Woodland Hills Elementary School at the southeast corner of South 95th Street & Stagecoach Drive. The following summarizes the findings and the geometric/operational recommendations.

Major roadway network

School traffic will initially be required to use Sugar Creek Drive or Booneville Road when traveling to/from the arterial streets. This puts more pressure on the collector streets within Woodland Hills. Residents may see a spike in traffic levels – as much as 250-300 vehicles each way – over a short amount of time immediately before and after school, and they may express concern over the collector streets being used as thru streets. Buses and other large vehicles would also be routed to the collector streets. However, the use of collector streets is expected to be temporary, as a large portion of the traffic is expected to shift to Stagecoach Drive once it is extended to other arterials.

School traffic circulation

The proposed school has two parking lots to separate buses (north lot) and parents (west lot) during the peak arrival and dismissal periods. The planned site layout, as well as the enrollment, is nearly identical to Maple Grove Elementary at 98th Street & Chalk Street. In order to anticipate potential issues at the new school, the existing traffic circulation at Maple Grove Elementary was observed on multiple occasions during the morning drop-off and afternoon pick-up periods.

The biggest problem that was observed at the Maple Grove Elementary site is that the parent pick-up/drop-off lane does not provide enough internal stacking to prevent queues from spilling onto 98th Street. This spillover is a result of the large number of parents that are attempting to use the drop-off/pick-up lane over a short amount of time. Vehicles were observed stopped on the public street and waiting to enter the site for about 12-15 minutes in the morning and about 18-21 minutes in the afternoon. The maximum queue was observed to extend as far as the Chalk Street intersection (seen in Figures 5 and 6). On-street queuing significantly reduces the capacity of the roadway, causing excessive delay (including for emergency vehicles) and driver frustration. This leads to aggressive and unsafe driving behavior. For example, some drivers that were headed to the parking lot were observed using the oncoming lane to pass the stopped vehicles and turning into the school via the exiting lanes. Thru vehicles on 98th Street were also observed weaving around the stopped vehicles.

Lengthy traffic queues at schools are partly caused by a very inefficient use of the drop-off/pick-up lane. Parents stop in the queuing lane in a haphazard manner, tending to stop closer to the entrance rather than pulling forward to the front of the queuing lane. They also tend to leave a sizeable gap between their vehicle and the vehicle in front of them so that they can leave easily if they leave first. Therefore, a queuing lane designed to handle 20 vehicles may only be handling 12-15 vehicles. The inefficient use of the queuing lane is compounded in the afternoon dismissal period since parents occupy the space from the time they arrive until the time when their child loads into the vehicle. The first vehicle in the queue may not be the first one to leave. As a result, there are more passing maneuvers and conflicts.

Recommendations

- In order to minimize the potential for on-street spillover, the site's west parking lot should be reconfigured to provide more on-site stacking. The current plan shows approximately 600' of

stacking space internal to the site, measured from the ROW boundary to the point where the first vehicle in the queue typically stops (according to the dismissal queue shown in Figure 5). Based on the queues observed at Maple Grove Elementary, the recommended minimum stacking distance is 1,100'. Potential modifications to obtain more stacking space are discussed on Page 15. If adequate on-site stacking space cannot be provided, a two-way left-turn lane (TWLTL) on South 95th Street between Stagecoach Drive and the school's driveway would be needed to stack vehicles on the public street and remove them from the thru lanes. However, providing enough stacking on-site is preferred so that other traffic on the public street is not impacted.

- Crosswalks should be clearly designated to reduce the potential for pedestrian/vehicle conflicts.

- Adult monitors (typically staff) should manage the arrival and dismissal periods. This allows schools to identify and proactively address on-site traffic problems. Also, drivers and children are less likely to disregard traffic control and engage in unsafe behavior when an adult is present. Adult monitors should wear safety vests to make them more visible and so that parents and children can easily identify them as authority figures. They should also encourage drivers to pull as far ahead as possible in the drop-off/pick-up lane and not leave vehicles unattended in order to use the space most efficiently.

- Traffic circulation should be monitored, making changes when necessary. Even the best management plans cannot always stop poor driver and pedestrian behavior. The school's arrival and dismissal procedure will only be effective if parents and students are educated, reminded, and held accountable. The following strategies are typically used:
  - Educate children and parents through orientation, parent-teacher conferences, school newsletters, and other correspondence.
  - Provide constant reminders by repainting markings, supervising the drop-off/pick-up times, confronting violators by talking to them immediately or putting a note on their windshield.
  - For repeat offenders, peer pressure can be used by involving Parent Teacher Organizations. As a last resort, police enforcement may be necessary if safety issues persist.

- The site layout must allow for emergency vehicle maneuverability. Signing, pavement markings, and other traffic control devices on the public streets and the driveway approaches to the public street should be in conformance with the *Manual on Uniform Traffic Control Devices* (FHWA, 2009).

- Recommendations for the major roadway network are given in the table below. These recommendations are due in part, but not entirely, to the traffic impacts of this development.

Location	Capacity/Safety Improvement	Notes
Stagecoach Drive	Extend to S. 88th St. as properties to the east develop.	
	At the same time as the roadway is extended, widen to its ultimate configuration.	*Between S. 88th and S. 90th:* four lanes with exclusive left-turn lanes and raised median *West of S. 90th:* four lanes with center TWLTL
S. 95th & Stagecoach	Signalize the intersection after Stagecoach Drive has been widened and conditions warrant.	Warrants based on volumes, crashes, etc.
	As the property to the north develops, construct SB approach.	100' left-turn lane with shared thru/right

Introduction

The City of West Des Moines has reviewed potential traffic impacts associated with development of the Woodland Hills Elementary School (part of the Waukee Community School District) at the southeast corner of South 95th Street & Stagecoach Drive. The school is planned to be approximately 96,000 SF with an ultimate capacity of 750 students. Figure 1 shows an overview of the area, and the attached plan shows the proposed site layout.

Figure 1: Site area

The site was originally analyzed as part of the *Tallyn's Reach Traffic Analysis* (Kirkham Michael & Associates, March 2006, with supplemental update in May 2006). That study analyzed the proposed land use plan in effect at the time and made recommendations for the major roadway network. No other traffic studies have been performed for this site in the 5 years since that study. However, there have been land use changes and traffic studies performed for other properties in the area. These studies include:

- *Edgewater/Michael's Landing Traffic Study Update* (Howard R. Green Company, July 2007)
- *Michael's Landing Plat 3 Traffic Analysis* (City of West Des Moines, March 2008)

Trip Generation

The original *Tallyn's Reach Traffic Analysis* analyzed the site as a part of a larger zone, referred to as Zone E in that study. Zone E is the area west of South 93rd Street between Stagecoach Drive and Sugar Creek Drive[1]. Figure 2 shows the Traffic Analysis Zone (TAZ) boundaries used in the 2006 study.

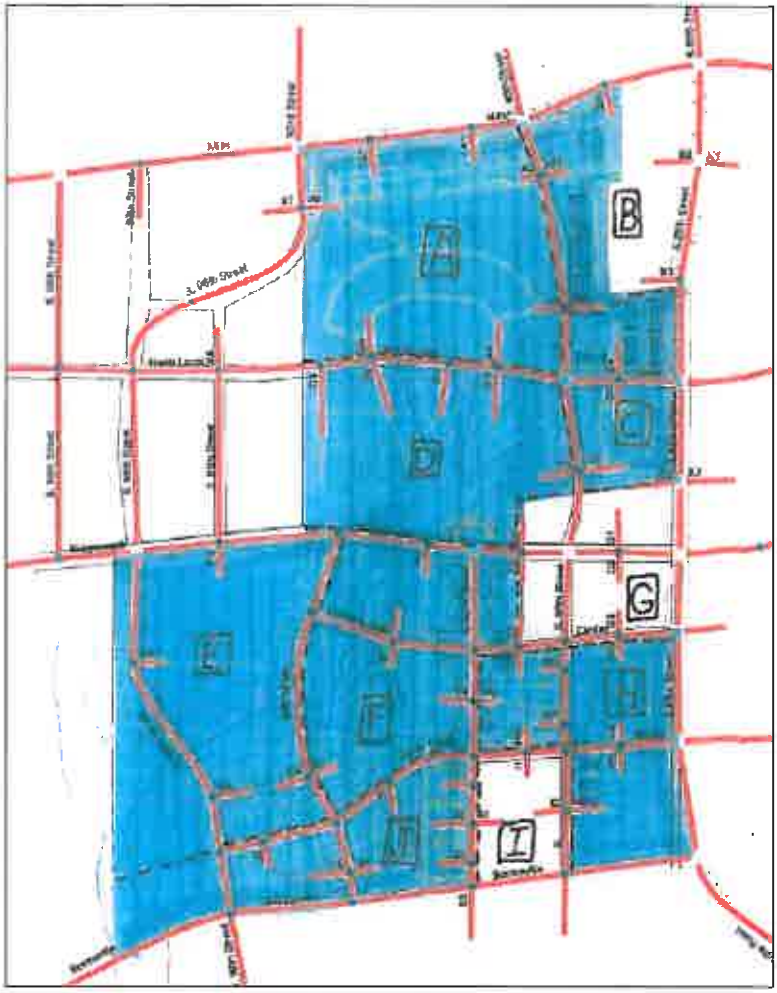


Figure 2: Traffic Analysis Zones (Source: *Tallyn's Reach Traffic* Analysis, KMA)

Zone E was assumed to develop as a mix of an elementary school, park, and single family residential, which is consistent with the current set of land uses.

The numbers of trips generated by the development were estimated in the *Tallyn's Reach Traffic Analysis* using the Institute of Transportation Engineers' *Trip Generation, Version 7*, which was the most recent version at the time. In order to use the most current data, *Trip Generation, Version 8*, was used for this analysis to estimate the numbers of trips generated on an average weekday, AM peak hour of adjacent street traffic, and PM peak hour of adjacent street traffic.

[1] In the Tallyn's Reach study, South 93rd Street was referred to as 94th Street and Sugar Creek Drive was referred to as South Local.

Compared to the original study, there are fewer single family lots in Zone E than previously assumed and the size of the school is larger. The expected number of students at the school increased from 600 students in the 2006 study to the current proposal of 750 students.

The estimated trip generation of Zone E is compared to the initial estimates in Table 1. Trips are given in terms of the total number of vehicle trip ends (entering plus exiting), including internal capture trips. Since both the square footage and number of students are known for this study, the trip generation was calculated based on both of the variables. The calculation based on square footage appears to be closer to what is being generated at comparable elementary schools. Therefore the trip generation was estimated for the proposed site with square footage as the variable.

Table 1: Woodland Hills "Zone E" – trip generation

ITE	Land Use	Est. Quantity	Units	Average Weekday Trip Ends			
				Daily	AM peak hour	PM peak hour	
TALLYN'S REACH TRAFFIC IMPACT STUDY (2006)							
210	Single Family Residential	78	du	746	59	79	*
411	Park	7.3	acres	12	1	1	*
520	Elementary School	600	students	774	252	168	*
			Total	1,532	312	248	
EXISTING/PROPOSED							
210	Single Family Residential	65	du	622	49	66	
411	Park/Greenway	15.7	acres	25	1	3	
520	Elementary School	95,968	sf	1,481	499	116	
			Total	2,128	549	185	
			Difference	596	237	-63	

* Trip generation previously estimated using ITE Trip Generation, Version 7

The total trip generation for Zone E is expected to be higher for an average weekday and AM peak hour, but lower for the average PM peak hour, compared to the initial trip estimates.

The estimated trip generation for the entire Woodland Hills development is shown in Table 2. Outlots which were analyzed in the 2006 planning area but are not parts of Woodland Hills are not included in the totals.

Table 2: Woodland Hills – trip generation

Zone	ITE	Land Use	Est Quantity	Units	Average Weekday Trip Ends AM peak hour	Average Weekday Trip Ends PM peak hour	
A	-	Edgewater development	mix		164	194	(1)
	710	Office	17.5	acres	295	284	
				Zone A total	459	478	
				Zone A estimate (Tallyn's Reach TIS, May 2006)	502	705	
				Difference	-43	-227	
B	-	Convenience Commercial	3.2	acres	333	217	
	710	Office	3.6	acres	61	58	
	220	High Density Residential	13.4	acres	123	149	
	710	Outlot - Office	7.0	acres	-	-	** OUTLOT - SEE NOTE BELOW
	220	Outlot - High Density	8.7	acres	-	-	** OUTLOT - SEE NOTE BELOW
				Zone B total	517	424	
				Zone B estimate (Tallyn's Reach TIS, May 2006)	413	437	
				Difference	104	-13	
C	230	Medium Density Residential	43	du	19	22	
				Zone C total	19	22	
				Zone C estimate (Tallyn's Reach TIS, May 2006)	81	96	
				Difference	-62	-74	
D	230	Medium Density Residential	38.4	acres	202	239	
	411	Park/Greenway	11.6	acres	1	2	
				Zone D total	203	241	
				Zone D estimate (Tallyn's Reach TIS, May 2006)	511	411	
				Difference	-308	-170	
E	210	Single Family Residential	68	du	49	66	
	411	Park/Greenway	15.7	acres	1	3	
	520	Elementary School	95,968	sf	499	116	
				Zone E total	549	185	
				Zone E estimate (Tallyn's Reach TIS, May 2006)	312	248	
				Difference	237	-63	
F	210	Single Family Residential	50	du	38	51	
	411	Park/Greenway	9.4	acres	1	2	
	230	Medium Density Residential	11.1	acres	59	69	
	220	High Density Residential	4.4	acres	40	49	
				Zone F total	138	171	
				Zone F estimate (Tallyn's Reach TIS, May 2006)	1,418	1,074	
				Difference	-1,280	-903	
G	230	Outlot - Medium Density Residential	10.9	acres	-	-	** OUTLOT - SEE NOTE BELOW
	220	Outlot - High Density Residential	4.4	acres	-	-	** OUTLOT - SEE NOTE BELOW
	-	Outlot - Neighborhood Commercial	9.3	acres	-	-	** OUTLOT - SEE NOTE BELOW
				Zone G total	-	-	
				Zone G estimate (Tallyn's Reach TIS, May 2006)	-	-	
				Difference	-	-	
H	220	High Density Residential	8.3	acres	76	92	
	-	Neighborhood Commercial	22.4	acres	1,192	1,849	(2)
				Zone H total	1,268	1,941	
				Zone H estimate (Tallyn's Reach TIS, May 2006)	683	547	
				Difference	585	1,394	
I	230	Outlot - Medium Density Residential	13.8	acres	-	-	** OUTLOT - SEE NOTE BELOW
				Zone I total	-	-	
				Zone I estimate (Tallyn's Reach TIS, May 2006)	-	-	
				Difference	-	-	
J	210	Single Family Residential	51	du	38	52	
	230	Medium Density Residential	6.0	acres	32	37	
				Zone J total	70	89	
				Zone J estimate (Tallyn's Reach TIS, May 2006)	49	68	
				Difference	21	21	
				Grand Total	**3,223**	**3,551**	
				Total allocation (Tallyn's Reach TIS, May 2006)	**3,970**	**3,583**	
				Difference	**-747**	**-32**	

Revised
Undeveloped
Developed

(1) HR Green traffic memo, July 2007

(2) Compilation of ITE categories - standard mix used for West Des Moines traffic modeling

Note: Outlots are not parts of Woodland Hills, but were analyzed as part of the 2006 planning area. Trips generated from these outlots were not included in the totals.

As shown in Table 2, once the entire Woodland Hills development is fully developed, the trip generation is expected to be slightly less than what was analyzed in the 2006 study. However, due to land use changes for the outlots (traffic zones "G", "I", and part of "B"), the entire planning area is estimated to generate about 700 PM peak hour trips more than what was previously analyzed. This is largely due to Zone G, which was assumed to develop as townhomes and is currently planned as neighborhood commercial.

Roadway Network

The site's west parking lot is accessed from South 95th Street, which is classified as a major collector roadway. The street currently runs from Stagecoach Drive to Booneville Road, as was shown in Figure 1. As the area continues to develop, the street is ultimately planned to extend north, intersecting with Mills Civic Parkway, and south, intersecting with Grand Avenue. This is shown in Figure 3.

The north parking lot is accessed from Stagecoach Drive, which is classified as a minor arterial roadway. Only a section of Stagecoach Drive is currently constructed between South 93rd Street and South 95th Street (see Figure 1). As the area develops, Stagecoach Drive will ultimately extend east, intersecting with South 88th Street and South Jordan Creek Parkway. It will also ultimately extend west, intersecting with the future South 105th Street.

Figure 3: Ultimate street circulation

Interim trip distribution

School traffic will initially be required to use Sugar Creek Drive or Booneville Road when traveling to/from the arterial street, since Stagecoach Drive is not expected to connect to South 88th Street prior to the school opening. It is expected that the majority of this traffic will be utilizing Sugar Creek Drive based on the existing street network and population areas. Sugar Creek Drive is a minor collector street with primarily residential land uses. It is expected that residents on the street will see a spike in traffic levels of as much as 250-300 vehicles (each way) over a short period of time immediately before and after school, and they may express concern over the street being used as a thru street. Buses and other large vehicles (e.g., construction, delivery) would also be routed to the collector streets.

Traffic patterns adjacent to the school will also be different initially than they will be in the future. Until Stagecoach Drive connects to South 88th Street, school traffic will be coming from the south via South 93rd Street or South 95th Street.

Full-build trip distribution

When the area is fully developed, it is expected that the majority of school traffic will use Stagecoach Drive either from the east or west. Although there will be more traffic generated by areas to the south including within Woodland Hills, the majority of traffic is still expected to be generated by areas to the north.

With Stagecoach Drive connecting to other arterial streets such as South 88th Street, the traffic levels on the collector streets (such as Sugar Creek Drive) will be reduced as drivers use more efficient routes. Buses and other large vehicles would also be rerouted to Stagecoach Drive rather than Sugar Creek Drive.

Immediately adjacent to the school, the shift in traffic patterns will put more demand at South 95th Street & Stagecoach Drive as more drivers turn at the intersection. This will ultimately trigger the need for a traffic signal in the future as thru volume on Stagecoach Drive increases over time.

Full-Build Traffic Volumes

Future traffic data was obtained from projections in the 2006 *Tallyn's Reach Traffic Analysis* and from full-build traffic modeling that has been performed for the area (which takes into account land use changes since 2006). These forecasts assume that all land uses and streets shown in the City's comprehensive plan map are fully developed. As in the original *Tallyn's Reach Traffic Analysis*, the peak hour of traffic was assumed to be the PM peak hour, which generally occurs around 4:30-5:30 PM. This peak hour is slightly after the school's dismissal time of 3:40 PM when traffic from the school is peaking.

The projected full-build PM peak hour traffic volumes are shown in Figure 4.

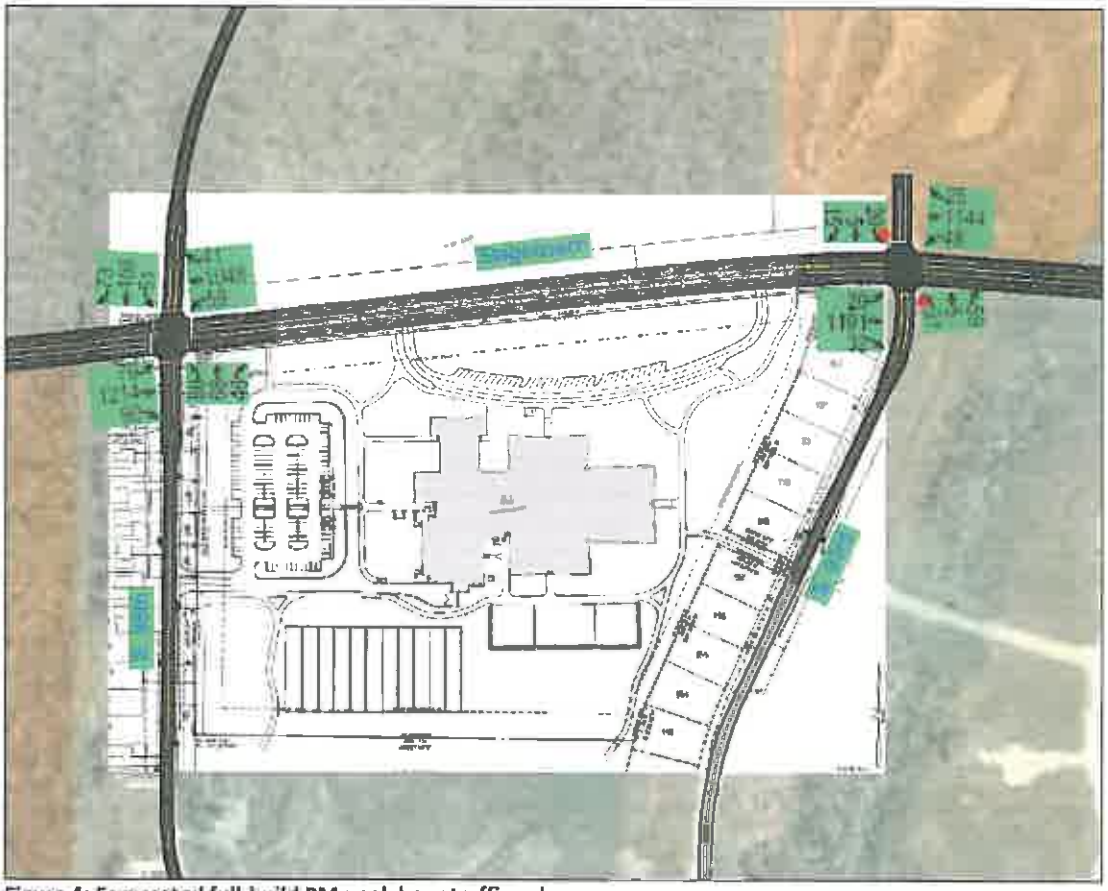


Figure 4: Forecasted full-build PM peak hour traffic volumes

The forecasted turning volumes at the intersections are comparable to projections in the 2006 *Tallyn's Reach Traffic Analysis*. However, the thru traffic on Stagecoach Drive is significantly higher than the 2006 projections due to increases in land use densities to the east (Aviva and surrounding area) and to the west (adjacent to South 105th Street).

Capacity Analysis

A capacity analysis for the major intersections in the area was performed using Synchro 8 traffic analysis software. Table 3 shows the forecasted levels of service (LOS) during the weekday PM peak hour of full-build. The capacity of the intersections was determined based on the recommended geometry and traffic control. LOS is measured on a scale of LOS A (very little delay) to LOS F (excessive delay). LOS D or better is desired for each intersection per the City of West Des Moines Comprehensive Plan.

Table 3: PM peak hour LOS (Left / Thru / Right)

Intersection	Approach	Full-Build LOS
S. 95th & Stagecoach 	Overall	C
	Delay (s)	25.2
	NB	C / C / C
	SB	C / D / D
	EB	B / C / C
	WB	B / C / C
S. 93rd & Stagecoach	NB	E / C / C
	SB	E / C / C
	EB	B / A / A
	WB	B / A / A

School Traffic Circulation

The proposed school has two parking lots:

- North parking lot: used by buses and staff, operating with one-way traffic
- West parking lot: used by parents[1], staff, and guests, with the drop-off/pick-up lane operating as one-way.

Approximately 50% of students are expected to be picked up by a private vehicle, which is comparable to other schools. The other half is expected to use the bus. The enrollment and planned site layout is nearly identical to Maple Grove Elementary (also within the Waukee School District).

Maple Grove Elementary – existing conditions

In order to anticipate potential issues at the new school, the existing traffic circulation at Maple Grove Elementary was observed. A total of 5 site visits were made to Maple Grove Elementary during the peak arrival and dismissal periods. Early dismissal days and days with special activities scheduled at the school were avoided to eliminate changes in typical traffic and pedestrian behavior. Data was, therefore, collected under "normal" traffic conditions. The dates of the site visits were:

- School arrival – December 5 (Monday) and December 12 (Monday)
- School dismissal – December 1 (Thursday), December 6 (Tuesday), and December 12 (Monday)

[Note: The dismissal period was observed on 3 occasions since there were snow flurries on December 1 that may have slightly affected traffic patterns. The other days had dry weather conditions and dry pavement.]

During all visits, on-street spillover was observed on 98th Street due to the large number of parents that are attempting to use the drop-off/pick-up space over a short period of time. Typically, on-street spillover and queuing is more likely to occur during the afternoon dismissal; however, in the case of Maple Grove Elementary, it was observed during both the morning arrival and afternoon dismissal periods.

[1] The term "parent" in this study refers to any driver responsible for getting a child to and from school and may not be the child's actual parent. The term is used for simplicity in writing this report.

Figure 5 shows the maximum queues that were observed, along with other notes on traffic circulation. These queues may vary slightly from day to day due to the random arrival of vehicles and presence of on-site conflicts.

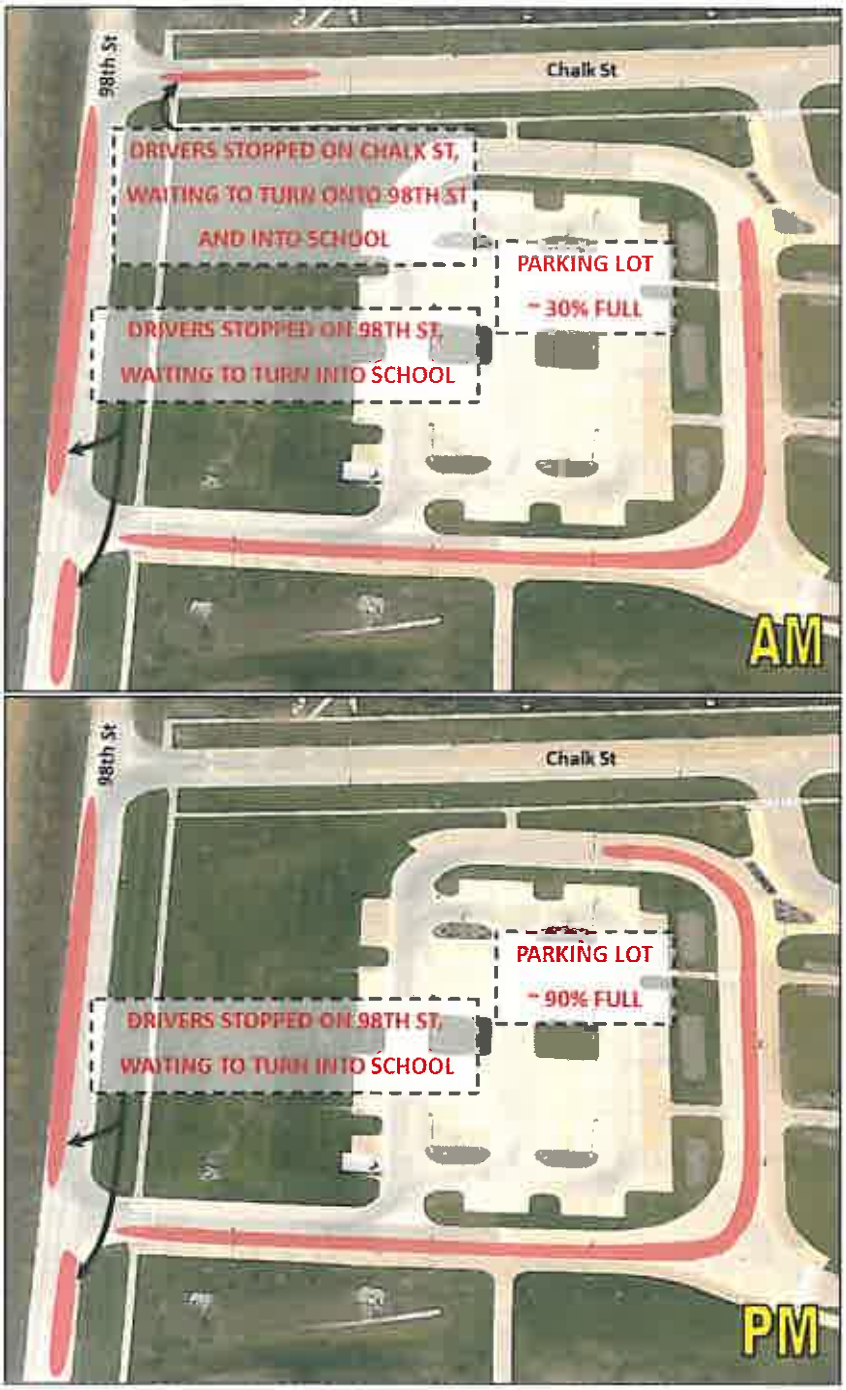


Figure 5: Maximum queues observed during the AM arrival and PM dismissal periods

AM Arrival

- School starts at 8:50 AM.
- About 20-25 minutes before the start of school, parents arrive faster than they leave, creating a queue along the curb.
- At 8:35, queued vehicles along the curb are backed out of the driveway to 98th Street.
- At 8:38, queued vehicles reach to Chalk Street. A few vehicles on Chalk Street must wait to turn left onto 98th Street.
- Time vehicles are stopped on 98th Street ~ 12-15 minutes.
- Time vehicles are stopped on Chalk Street ~ 6 minutes.
- At 8:48, the last stopped vehicle turns off of 98th Street.

PM Dismissal

- School dismisses at 3:40 PM.
- Some parents arrive more than 30 minutes prior to dismissal to park near entrance.
- At 3:30, queued vehicles along the curb are backed out of the driveway to 98th Street.
- At 3:38, queued vehicles approach the Chalk Street intersection.
- Time vehicles are stopped on 98th Street ~ 18-21 minutes.
- At 3:49, the last stopped vehicle turns off of 98th Street.

Figure 6 shows a picture of the school traffic spilling over onto the public street system as drivers wait to enter the school property.

Figure 6: Vehicles backed up to the 98th & Chalk intersection, as drivers wait to enter the school

On-street queuing significantly reduces the capacity of the roadway and causes excessive delay and driver frustration. This leads to aggressive and unsafe driving behavior. For example, during the afternoon dismissal period, some southbound drivers that were headed to the parking lot were observed using the oncoming lane to pass the stopped vehicles and turning into the school via the exiting lanes. Thru vehicles on 98th Street were also observed using the wrong lane to weave around stopped vehicles.

During the times of congestion, it would be difficult or impossible for emergency vehicles to access the school site in a timely manner. It would also delay emergency vehicles that are using the adjacent roadways en route to an emergency.

Traffic volumes are typically higher in the morning arrival period than in the afternoon dismissal period. However, there were fewer conflicts observed on school grounds during the morning arrival period and the on-street spillover occurred for a shorter time (approximately 13 minutes compared to 20 minutes for the afternoon dismissal period). This is likely due to the fact that many parents are usually able to drop off children and then leave immediately. As a result, they spend less time on the school site. This tends to use the drop-off/pick-up lane more efficiently in the morning than in the afternoon. However

in both the morning and afternoon, parents stop in the drop-off/pick-up lane in a haphazard manner, tending to stop closer to the entrance rather than pulling forward to the front of the lane. They also tend to leave a sizeable gap between their vehicle and the vehicle in front of them so that they can leave easily if they leave first. This causes an inefficient use of the limited space that is available. A queuing lane designed to handle 20 vehicles may only be handling 12-15 vehicles.

The inefficient use of the queuing lane is compounded in the afternoon dismissal period since parents occupy the space from the time they arrive until the time when their child loads into the vehicle. The first vehicle in the queue may not be the first one to leave. As a result, there are more passing maneuvers, conflicts, and inefficient use of space in the afternoon.

The congestion seen in Figures 5 and 6 are due to parent drop-off/pick-up. Staff traffic appeared to be staggered long enough before and after the peak periods that it was not a significant contributor to the congestion. However, in the afternoon dismissal period, approximately 40% of the west parking lot is used by employees or other adults not picking up students. This limits the amount of parking spaces available for parents picking up students and may encourage parents to stay in the queue lane even when the queue lane is congested.

Recommendations

The following sections expand on the findings of the analysis and give geometric and operational recommendations for the study area.

Existing & interim configurations

The *Tallyn's Reach Traffic Analysis* recommended the following interim configurations as minimums.

- Stagecoach Drive: two-lane west of South 90th Street
- South 95th Street: two-lane with separate lefts
- South 93rd Street: two-lane with separate lefts

These are the existing lane configurations; however, Stagecoach Drive currently does not extend east of South 93rd Street.

Ideally, Stagecoach Drive would be extended to South 88th Street prior to the opening of the school. Otherwise, school traffic must use collector streets (South 95th Street, South 93rd Street, and Sugar Creek Drive) as thru streets to access South 88th Street. The impacts of this temporary distribution are discussed in the "Interim trip distribution" section on Page 8.

Full-build configurations

The extension of Stagecoach Drive to the arterial streets will provide immediate benefits to the collector street system within Woodland Hills that, up until that time, will be handling much of the development's traffic. The roadway should be extended to South 88th Street as properties to the east develop. When Stagecoach Drive is extended, it should be widened to its ultimate configuration:

- Stagecoach Drive between South 88th Street and South 90th Street: four lanes with exclusive left-turn lanes and raised median.
- Stagecoach drive west of South 90th Street: four lanes with center two-way left-turn lane (TWLTL).

Depending on traffic levels on South 88th Street and the buildout portion of the area at the time it occurs, the Stagecoach Drive connection is likely to trigger signalization of the South 88th Street & Stagecoach Drive intersection. More analysis of the South 88th Street & Stagecoach Drive intersection will be necessary as part of future studies.

Signalization is also expected in the future at the intersection of South 95th Street & Stagecoach Drive. The intersection should be signalized once thru volumes on Stagecoach Drive increase and an engineering study indicates that a traffic signal will improve the safety and operation of the intersection. As was noted in Table 3, the full-build peak hour LOS is projected to be above the LOS D standard with the following recommended geometry:

- *Northbound:* Left-turn lane and one thru lane with shared right (existing)
- *Southbound:* 100' left-turn lane and one thru lane with shared right
- *Eastbound:* 150' left-turn lane within TWLTL and two thru lanes with shared right
- *Westbound:* 200' left-turn lane within TWLTL and two thru lanes with shared right

Signal timing plans should be developed to specifically handle the school's peak periods. Additional green time for the northbound phases will be needed during those times to help clear vehicles quickly and reduce the length of the northbound queue.

At the stop-controlled intersection of South 93rd Street & Stagecoach Drive, the full-build LOS during the PM peak hour is projected to be LOS E for the side street approaches. Drivers will be forced to wait for an acceptable gap or use other routes (such as the future signal at South 95th Street & Stagecoach Drive) to turn left during heavy traffic periods. The intersection is not expected to meet signalization warrants based solely on the forecasted traffic volumes.

Driveways and internal circulation

The site layout must allow for emergency vehicle maneuverability. Signing, pavement markings, and other traffic control devices on the public streets and the driveway approaches to the public street should be in conformance with the *Manual on Uniform Traffic Control Devices* (MUTCD, Federal Highway Administration, 2009).

The proposed school layout is nearly identical to Maple Grove Elementary. The student enrollment is also similar (currently almost 700 at Maple Grove Elementary and a planned capacity of 750 at Woodland Hills Elementary). Therefore, the traffic circulation at Woodland Hills Elementary is expected to be very similar to the existing traffic circulation at Maple Grove Elementary. As discussed previously, the biggest issue with that layout is that the pick-up/drop-off lane does not provide enough internal stacking to prevent queues from spilling onto the public street. On-street queuing then leads to excessive delay and drivers passing in the oncoming lanes.

In order to minimize the potential for on-street queuing, the site's west parking lot should be reconfigured to provide more on-site stacking. The current plan shows approximately 600' of stacking space internal to the site, measured from the ROW boundary to the point where the first vehicle in the queue typically stops (according to the dismissal queue at Maple Grove Elementary, shown in Figure 5). Based on the queues observed at Maple Grove Elementary, **the recommended minimum stacking distance is 1,100'.**

Modifications that should be considered in order to increase the internal stacking distance are:

- Shift the driveway on South 95th Street closer to Stagecoach Drive, but no closer than 225' (measured center to center) to maintain adequate corner clearance.
- Shift the loading zone closer to the school.
- Expand the queue lane to the south.

A conceptual layout is shown in Figure 7.

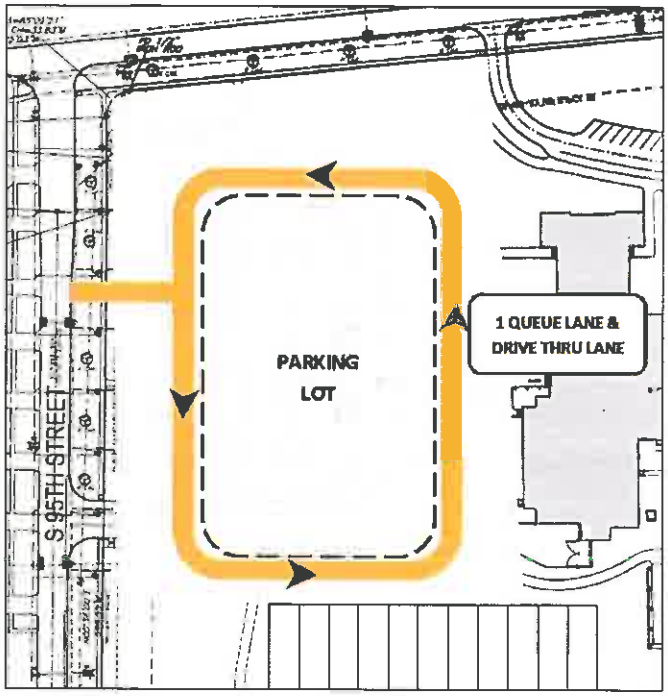


Figure 7: Example of modified drive location and parking lot to provide more internal stacking

Similar to Maple Grove Elementary, the loading zone is planned to consist of only one queue of traffic, with drivers able to use the left lane to drive through. This is to prevent vehicles from forming two lines in the loading area. However, double queues can be effective at maximizing the space available for passenger cars. This should only be used if the queued vehicles are allowed to form two lines only until a point where they alternate to form a single line for drop-off/pick-up. Also, there needs to be supervision by adult monitors to be sure that children are not being loaded or unloaded from vehicles in the double queue zone.

A conceptual layout of the double queue zone is shown in Figure 8.

Regardless of the internal layout, at least 1,100' of internal stacking is recommended so that the probability of on-street spillover is minimized. If this amount of stacking cannot be provided on-site, a TWLTL on South 95th Street between Stagecoach Drive and the school's driveway would be needed to stack vehicles on the public street and remove them from the thru lanes. However, providing enough stacking on-site is preferred so that other traffic on the public street is not impacted.

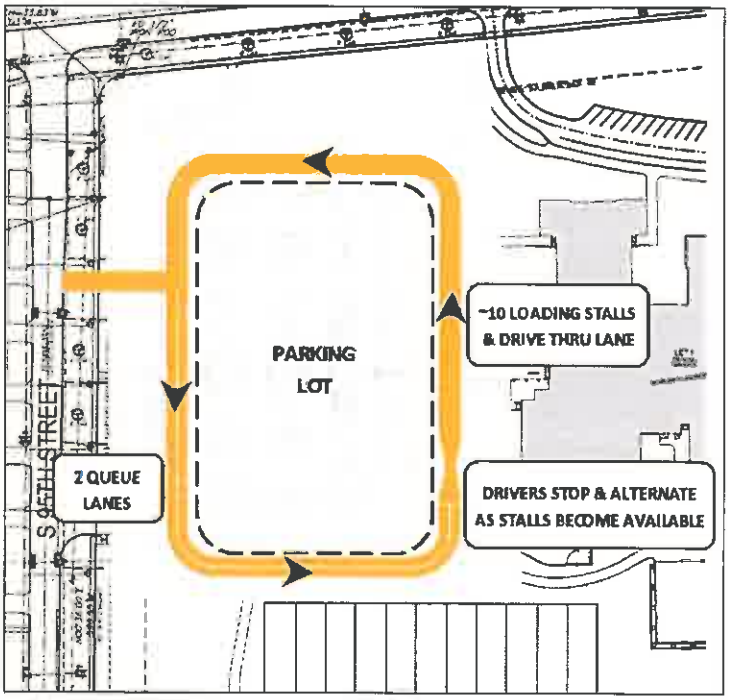


Figure 8: Example of modified drive location, parking lot, and double queue zone

The driveways on Stagecoach Drive are planned to operate as one-way. The west driveway (entrance only) is planned to be located approximately 440' east of South 95th Street, or about 680' west of the planned east driveway. The east driveway (exit only) is planned to be located approximately 290' west of South 93rd Street. These corner clearances are adequate for full-build.

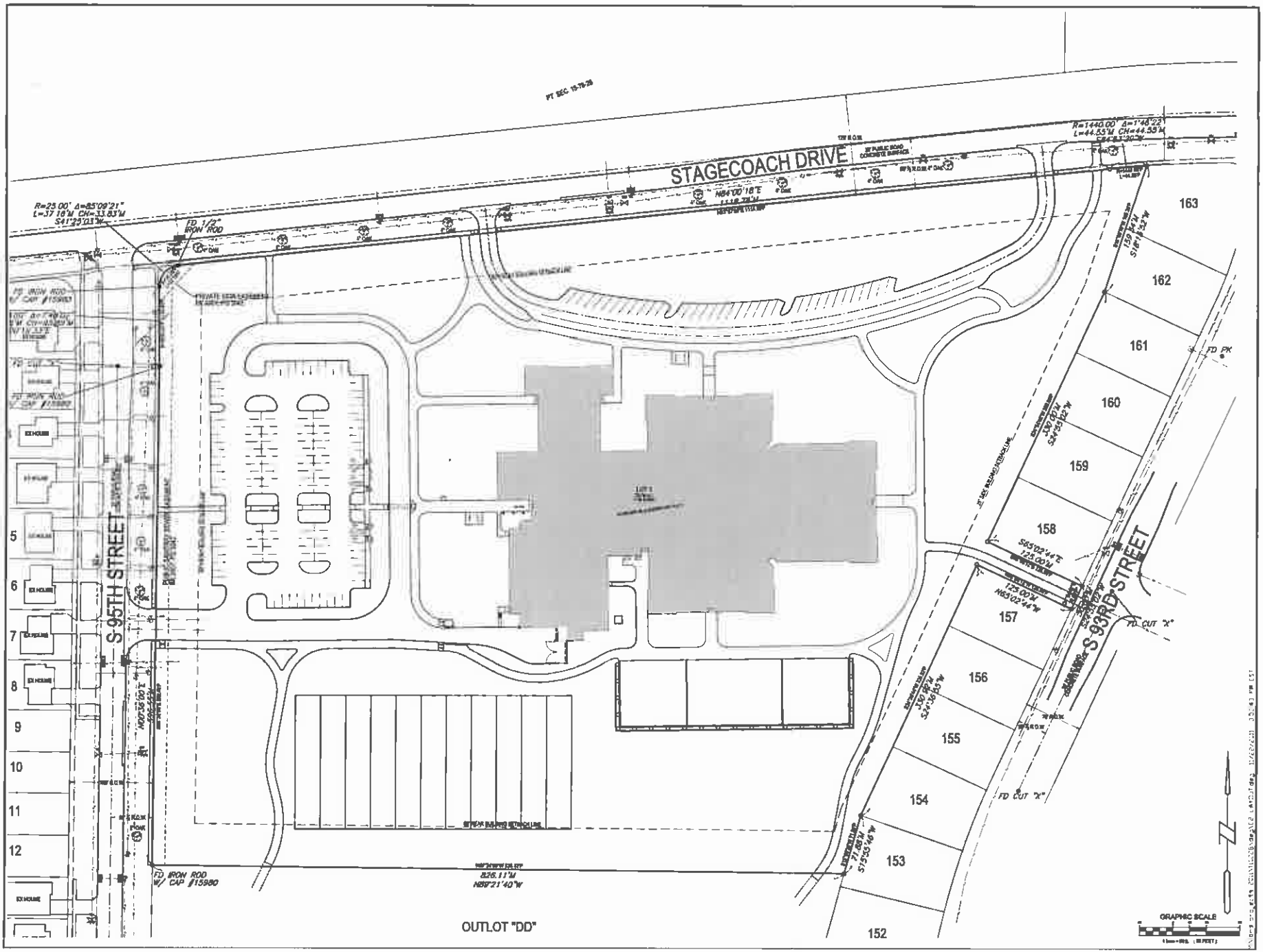
Good internal circulation practices at Maple Grove Elementary, which are also recommended at this site, are noted below:

- As planned for the new school, buses and private vehicles are separated by having two parking lots. This separates conflicts from the two modes.
- Crosswalks are clearly designated through the parking lot. This eliminates instances where children are crossing chaotically between vehicles.
- Adult monitors (typically staff members) manage the arrival and dismissal periods. This allows schools to identify and proactively address on-site problems. Also, drivers and children are less likely to disregard traffic control and engage in unsafe actions when an adult is present. Adult monitors should wear safety vests to make them more visible and so that parents and children can easily identify them as authority figures. They should also encourage drivers to pull as far ahead as possible in the drop-off/pick-up lane and not leave vehicles unattended to use the space most efficiently.

As with any drop-off/pick-up management plan, traffic circulation should be monitored and changes made, when necessary. It should be noted that even the best management plans cannot always circumvent poor driver and pedestrian behavior. Installing signs or pavement markings are helpful for drivers, but they do not change driver behavior if they are not enforced. Therefore, signs and markings should be limited to those that are most critical and will be enforced.

The school's arrival and dismissal procedure will only be effective if parents and students are educated, reminded, and held accountable. The following strategies are typically used to reinforce the drop-off/pick-up management plan:

- Educate children and parents through orientation, parent-teacher conferences, school newsletters, and other correspondence.
- Provide constant reminders by repainting markings, supervising the drop-off/pick-up times, confronting violators by talking to them immediately or putting a note on their windshield.
- For repeat offenders, peer pressure can be used by involving Parent Teacher Organizations. As a last resort, police enforcement may be necessary if safety issues persist.



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WOODLAND HILLS ELEMENTARY SCHOOL
WAUKEE COMMUNITY SCHOOL DISTRICT

PROJECT NO: 1018J
DATE: NOVEMBER 201
REVISIONS:
DRAWING TITLE: LAYOUT PLAN
DRAWING NO: C-202